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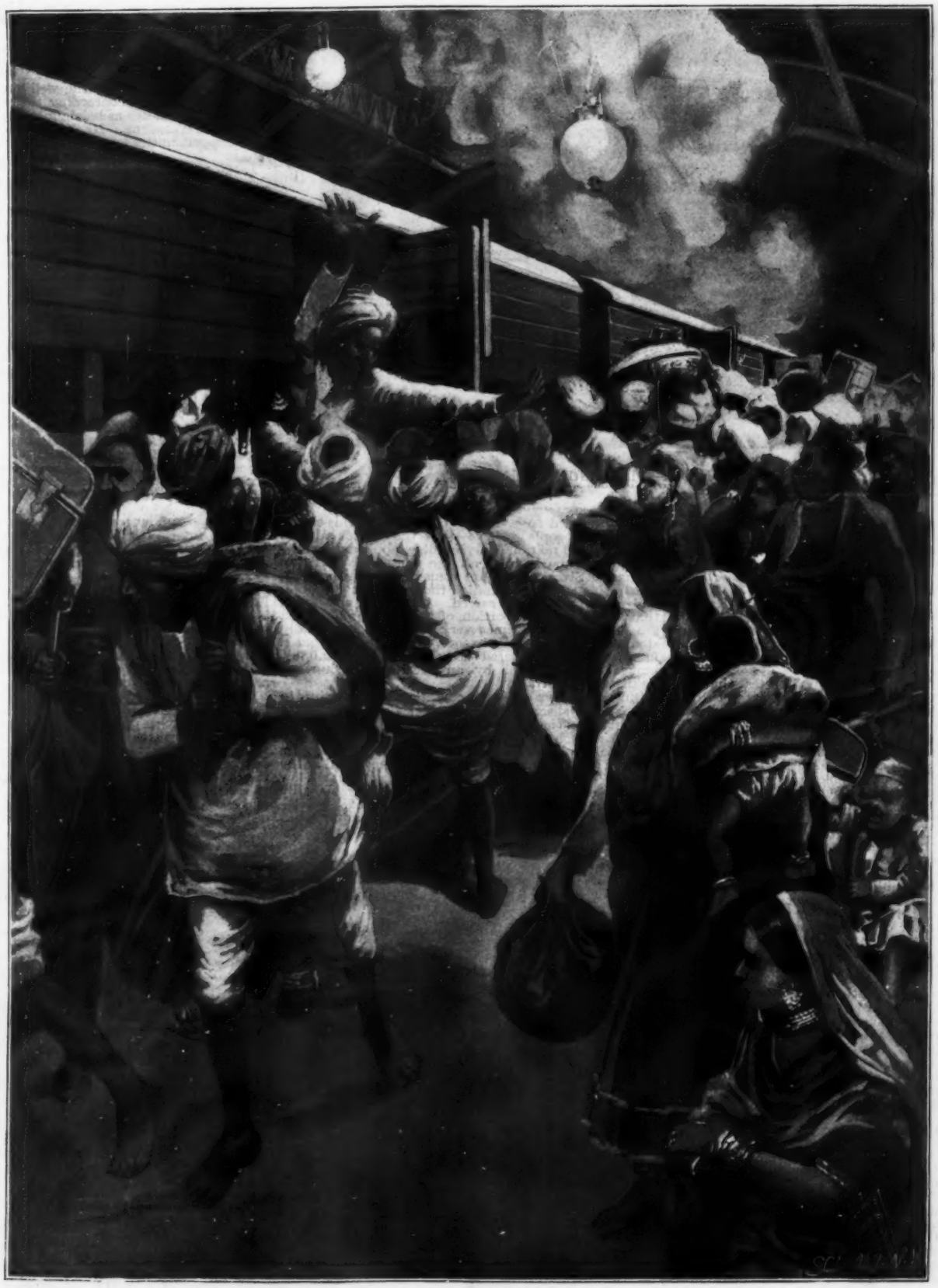


THE PLAGUE IN INDIA—THE EXODUS FROM BOMBAY.

THE FAMINE IN INDIA.

THE problem of the plague in India is complicated by the famine, which is very widespread. The grain which was sown in January will not be reaped until March, April or May; the prospect for the remainder of the year would depend on the monsoon winds beginning from the northwest in the latter part of June, when the autumn crops should be sown. The monsoon winds are usually prolonged to the end of October, changing their direction and bringing needful rain. In the Punjab, where more than one-third of the area is cultivated for grain, the land is artificially watered by irrigation and here the population has more money than in some other provinces, so that the misery occasioned by a hard season may be less severely felt.

Former calamitous years have shown that, while few of the natives die of actual starvation in their own village homes, the greatest difficulty is caused by large multitudes of them wandering about—men, women and children—in other districts where they are strangers and where no preparation has been made for their support. This drifting around of the ignorant and helpless people, of course, throws into confusion the local arrangements of the food stores and camps of shelter, public works that give employment, kitchens and hospitals, provided by the government; and the official task of administering relief would be almost impossible, were it not for the extension of the roads, canals and railways effected during the past thirty years.

THE FAMINE IN INDIA—DISTRIBUTING FOOD.

The London Times of March 5 states that the Viceroy's report to the Secretary of India for the preceding week states that rains have fallen in several of the affected districts. The number of persons on the government relief rose to 3,141,000.

Reuter's special correspondent has now arrived at Sirsa (Punjab), after a tour through the Southern Punjab. At Delhi the commissioner informed him that the government had sanctioned the making of canals and tanks, which would afford employment until July.

In Delhi city the pinch is greatly felt by gold and silver wire workers, jewelers, and embroiderers, for no Hindoo marriages now take place, and, consequently, there is no demand for wedding garments. Even the descendants of the Delhi royal family, who are government pensioners, are unable to meet the high prices, and are receiving private charity in addition. A very considerable number of other respectable people, too proud to enter the relief works, are suffering the direst poverty. Another outlet for the English famine fund is found among the pardah women.

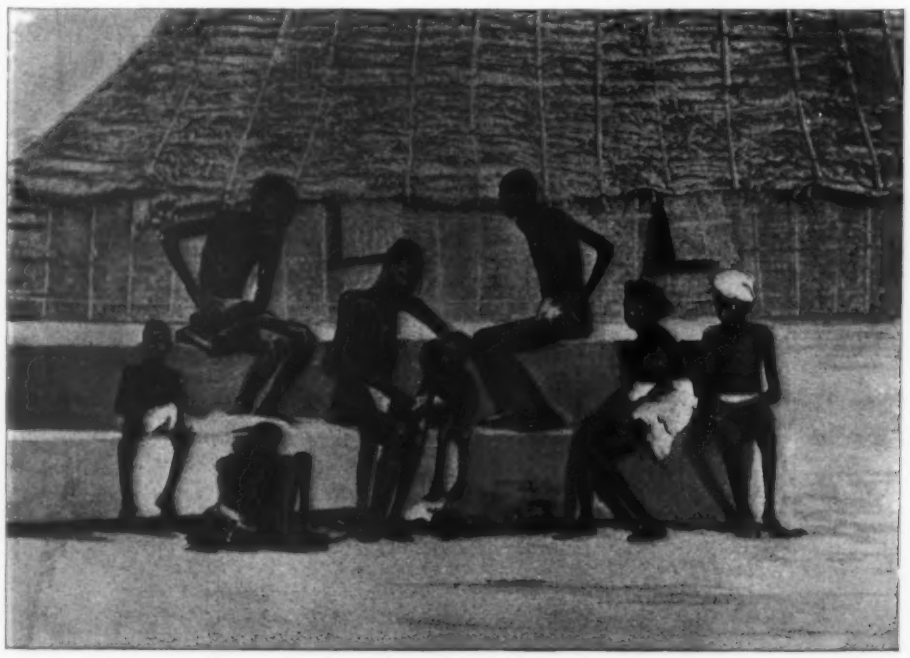
At the public kitchen at Delhi 1,000 of the poorest classes are fed daily, each receiving a number of chapatties. There are separate kitchens for Hindoos and Mahometans under municipal management.

Hissar, the worst district of the Punjab, was found absolutely destitute of crops, having suffered from scarcity in the two previous years, and 40,000 cattle, or 23 per cent. of the total, have already died. Mortgages on land have increased 300 per cent., and the land is falling into the hands of usurers. One use of the relief fund must be to help in the liquidation of debts.

The Ghaggar canal extends through 24 miles of British and 24 of Bikaner territory, and has two branches. The scientific collection and distribution of water from the Ghagger River is now employing 45,000 men. At the head of the canal a flood embankment 20 feet high and two miles long is being made. The people seem contented with their wages, and are willing to do the work. The elaborate huts erected by the government are disliked, the people preferring reed screens or French tentes d'abri of field pattern. In this district the roads are almost useless. There is no vehicular traffic, but camels, bullocks, and donkeys are employed.

The mass of the people of India are simpleminded and remain yet in a very primitive condition. They will worship almost anything, particularly if it is purana, or old, as a god. In their misery in the midst of dire hunger and pestilence they naturally turn to all their objects of worship to seek relief. Noted shrines are flocked to and the gods are implored for assistance. Many, in their last agony, go out in such hopeless endeavors, and fail to return. Among the traditions of the mythic period in India is one of a celebrated cow that belonged to Vasishtha. The animal was known as the "Cow of Plenty," called Nandini, and it had the power of granting whatever its possessor desired. This cow is yet sacred in India, and figures of it are naturally frequented in times of scarcity by suppliants who hope that it may still be the "Cow of Plenty." Hindoo maidens also go out to the fields and perform suitable ceremonies by which they invoke the gods to send rain. The bunniahs, or shopkeepers who deal in grain, are believed by these simpleminded people to use charms to prevent the clouds from coming with the desired relief, so as to raise the value of their stock. It is told of one that for this purpose he had a wheel made of dead men's bones, and whenever the clouds began to appear he made his virgin daughter turn the wheel—not "sunwise," which is the lucky way in India as it is here in the West, but against the course of the sun; and so great was the power of this charm—as these people believe—that the clouds always dispersed, and no rain fell. Nandi is a bull, and images of him may be seen at all the Ghats, for he is the Wahan of Siva. There are some very large figures of this bovine creature in India; these are, of course, old, and consequently very sacred. When it is considered that a very large proportion of the populace of India are at the best of times very poor and their daily struggle for a bare subsistence, it will be seen that a famine or any increased scarcity of food is almost immediately followed by an increased amount of sickness and mortality.

Our engravings show the condition of the natives in the famine stricken districts and the exodus from Bombay. In the middle of February it was estimated that 75 per cent. of the inhabitants had left Bombay. The operatives from the great mills with their families added a quarter of a million of the unemployed in the country districts. The streets and bazars that a few weeks ago were teeming with life are now virtually deserted. Many shops and offices are closed. One result of the plague and the famine has been the great diminution of all kinds of crimes except burglaries and petty thefts. These in many cases are due to poverty. There are so few cases that the high court of justice does not have business enough to occupy more than one-half its time. The panic at Bombay is now somewhat abated, but during the worst of the scare it may fairly be said that thousands of the people were running away from the place as if some one were pursuing them. All the roads were crowded with people carrying bundles of their belongings and dragging their children behind them. The steamboat wharves and railway stations were greatly crowded. We present an engraving of the scene in the great railroad station at Bombay. This station is probably the largest railroad station in the world and is the greatest modern architectural work in India. It is called the "Peninsula Railway Victoria Terminal Building." It was named on the Jubilee day of Queen Victoria. The total length of the building is over 1,500 feet. The style is Venetian Gothic with Oriental modifications. It is handsomely decorated with statues and the principal feature of the edifice is the large central octagonal dome of solid masonry, which has a very fine effect and may be seen from any part of the city. The execution of the work occupied ten years and the cost is estimated at $18,900,000. We are indebted for our engravings to the London Illustrated News and Black and White. The particulars are from the London Lancet, London Illustrated News, and the London Times.



THE FAMINE IN INDIA—LIVING SKELETONS.

THE JEWELS OF ROYALTY.

MR. GEORGE F. KUNZ, the well known gem expert, writes the following, concerning the rare specimens of jewels in the collections belonging to reigning families, in the New York Sun. Mr. Kunz has had some exceptional opportunities for closely examining many of the jewels.

Large gems have always had a great charm to the Orientals, who have always paid more for them than the Europeans. The Orient hides within her jealously guarded palaces many fine collections of jewels. The Nizam of Hyderabad owns the Victoria diamond, for which he paid $2,000,000. The Maharajah of Tanjore is likewise possessed of a rich store of gems, many of them rare and curious. The Maharajah of Baroda paid $100,000 for the 125 carat Star of the South, and also bought the 225 carat pale yellow De Beers diamond exhibited at the 1889 exposition.

According to the testimony of S. G. W. Benjamin, at one time United States minister to Persia, the late shah had a very remarkable collection of gems, estimated to be worth between $10,000,000 and $15,000,000, but it is almost impossible to get reliable information about them, so closely are they guarded. The same may be said of the Sultan of Turkey's collection, valued at over $10,000,000.

When the English took possession of the palace of King Theebaw at Mandalay, Burma, they searched eagerly for the fabulous treasures which it was supposed this Oriental monarch possessed. They were doomed to disappointment. Nothing of any special value was found, the far famed jewels consisting of a miscellaneous lot of poor emeralds and rubies. Many of them were of large size, but so inferior in quality that the English regalia could not be enriched by adding any of them. So little are they valued that they are now exhibited in glass cases in the Indian Museum in London.

Many of these Oriental collections, according to Sir Edwin Arnold and other Oriental travelers, are kept in isolated rooms. Sometimes the gems are wrapped in rags or concealed in ginger jars, old boxes, and out of the way places, so that even an intimate visitor may be a guest for weeks and only occasionally see a jewel, and only when he has the entire confidence of his host are the treasures shown one at a time.

Of all the costly wonders that the palace of the Mogul emperors at Delhi contained, the most wonderful and the most costly was the peacock throne. This was constructed during the reign of Shah Jehan, and was the work of a Frenchman, Austin, of Bordeaux, who had sought refuge at the Mogul's court. It was estimated that the value of the throne was £6,000,000 sterling. It stood in the center of the beautiful hall of private audience, and was named after the figures of two peacocks standing behind it, their tails being expanded,

and the whole so inlaid with sapphires, rubbies, emeralds, pearls, and other precious stones of appropriate colors as to represent life. The throne itself was six feet long by four feet wide; it stood on six massive feet, which, with the body, were of solid gold inlaid with rubies, emeralds and diamonds. It was surmounted by a canopy of gold supported by twelve pillars, all richly embiazoned with costly gems, and a fringe of pearls ornamented the border of the canopy. Between the two peacocks stood the figure of a parrot of ordinary size, said to have been carved out of a single emerald. On each side of the throne stood an umbrella, one of the Oriental emblems of royalty. They were formed of crimson velvet thickly embroidered and fringed with pearls, the handles, eight feet high, being of gold studded with diamonds. It has been held that the famous Kohinoor was one of the jewels that ornamented the throne, and as this diamond, now in possession of Victoria, was owned by Shah Jehan, the story may be true. When Delhi was sacked by the Persians under Nadir Shah in 1739 the throne was plundered of its jewels, broken up and carried away, with $750,000,000 of loot. A block of white marble now marks the spot where it once stood.

Catherine II and Peter the Great of Russia were lovers of precious stones, and collected fine examples of the jeweler's art, which are preserved, together with other precious relics, in the Kremlin in the Ouregena Palata, at Moscow. Here are thrones studded with diamonds, rubies, turquoises, pearls, emeralds and sapphires; an orb containing a ruby weighing forty-nine carats, and swords and scimitars thickly studded with gems. The jewels proper, which are inclosed in cases, include workmanship of Renaissance, Byzantine and Persian handiwork, all by master hands. The wealth of gems used is amazing. Stones cut and uncut, some of the largest size, shine in these regalia. Most wonderful of all is the coronation crown of Catherine I, made especially for her by order of Peter the Great. There are 2,358 diamonds in this crown, and over the brow is a magnificent ruby. In a separate case are placed all the jewels worn by the empress and grand duchess on state occasions; and among diamonds the gems galore is a very large pink diamond which belonged to Peter the Great. In state silver and gold ware this collection is unsurpassed, and her monarchs have been purchasing continuously for three centuries, and never selling their possessions.

In France Louis XIV and Louis XV took particular interest in this subject. It was at the suggestion of the former that Tavernier, the great traveler, made his search for gems in so many countries of the world, and unearthed the "blue diamond."

In 1887 the French crown jewels were sold at public auction by order of the government, realizing some 7,500,000 francs. These jewels included all but two of the Mazarin diamonds and many gems worn by the unfortunate Marie Antoinette. About one-third of the entire amount auctioned off was purchased by one American. The great Regent diamond was not sold. This and two Mazarin diamonds are now on exhibition in a case in the Galerie d'Apollon, in the Louvre. Probably the more luxurious and resplendent mirror is now in the Louvre, originally possessed by Queen Marie de Medici. It is of rock crystal, and the frame was of polished agate set in a network of enameled gold. This was but the inner frame. The outer one was composed entirely of precious stones, consisting of sardonyx, jasper, rubies, emeralds and diamonds. When the inventory of the crown diamonds was taken in 1791 by order of the National Assembly, this work of art was valued at 150,000 francs. It is now in the Louvre.

The English royal collection has been a gradual growth. The present repository of the English regalia is the Tower of London. After the execution of Charles I some of the older objects were broken up and dispersed, and at the restoration it was necessary to reconstruct many of them for the king's coronation. Nearly all the historical pieces date no further back than the time of Charles II. The ancient regalia comprises two crowns, an orb, a scepter with a cross, a scepter with a dove, a long scepter of gold, a ring with a ruby, and several minor articles.

The most conspicuous and valuable object in the collection is the crown of Queen Victoria, made for her coronation in 1838, many of the jewels being of great antiquity. In one of the crosses in front of the crown is set the famous ruby which belonged to the Black Prince. The crown contains in all 2,783 diamonds, 277 pearls, 5 rubies, 17 sapphires and 11 emeralds.

In the treasury of the imperial and royal house of Austria, at Vienna, are some remarkable specimens of work in rock crystal, ewers, flagons and tankards, ornamented and engraved with elaborate scenes and landscapes and set with enamel, gold and precious stones. These pieces were used at the coronation of the Austrian kings, or for their domestic service. A vase in the same collection is formed of a single Peruvian emerald weighing 2,680 carats, which is said to have been part of the treasure of Burgundy. Here, also, is the imperial crown of Austria, made during the reign of Rudolph II. It is of pure gold, richly adorned with diamonds, pearls and rubies. The circlet is of gold, encircled with large flat diamonds and pearls, two ranges of deeply set pearls decorating the border. The upper border of the circlet is adorned with four large and four small fleur de lys ornaments bearing large rubies, diamonds and pearls. The skeleton of the cap is composed of broad stripes of enamel, accompanied by a range of pearls on either side of the hoop which divides the cap into two halves. Each half is formed by two triangular plates of gold, on which the principal scenes of the coronation are wrought in bass-relief. The hoop is surmounted by a little cross adorned by a sapphire of matchless beauty. This is one of the most remarkable specimens of German goldsmith's work extant, and in point of value and general workmanship is unique of its kind.

The imperial orb is very similar in style. The scepter probably made for the coronation of the Emperor Mathias in 1612 is somewhat similar in workmanship, but probably the most striking of all the jewels here displayed is the diamond crown of the Empress, whose value exceeds 1,500,000 florins. The finest gems in this crown, remarkable in size, brilliancy and polish, were part of the private jewels of the Empress Maria Theresa.

In the insignia of the order of the Golden Fleece, which contains 150 diamonds of great beauty, is the "Frankfort solitaire," a gem of the finest water, weighing forty-two carats, purchased by the Emperor Francis I at Frankfort. Several other decorations of the Golden Fleece are also worthy of notice, one among them containing seven brilliants weighing in the aggregate over eighty-nine carats, while still others have large topazes, hyacinths, garnets or chrysolites clustered round with diamonds. A grand cross of the military order of Maria Theresa contains a rose colored brilliant of twenty-six and one-eighth carats; a complete parure of rubies, consisting of a tiara, a girdle, necklace, a pair of earrings and a watch, is interesting because of the fine quality of the gems, and also because it formerly belonged to the illfated Marie Antoinette, Queen of France.

Here is preserved the rose necklace of Maria Theresa, comprising thirteen rose brilliants, large sized brilliants filling the centers, and eleven pendeloques set with large solitaire brilliants of wonderful beauty. The famous Florentine diamond, one of the largest diamonds known, actually fills the trivial role of a hat button in the midst of this bewildering display. It weighs 133⅓ carats, is sherry colored, and is so cut as to form a star with nine rays. The stone was once the property of Charles the Bold, of Burgundy, who used to carry it into battle with him as a talisman. He lost it at the battle of Morat in 1476, and after many changes of ownership, and a lapse of over 300 years, it came into the Austrian treasury through the marriage of the Duke of Tuscany with Maria Theresa. Buttons for coats, waistcoats and hats are formed, each one or more, of magnificent topazes set round with brilliants. A large hyacinth weighing 416 carats is fashioned into the body of an eagle, and a set of pearl necklaces and bracelets contains over 480 pearls of varying size, some very large and fine. This faultless collection reflects the taste and judgment of Maria Theresa.

The famous Green Vaults of Dresden contain the jewels of the royal Saxon family from earliest times, and are one of the most wonderful treasure houses in the world. The crown jewels in the jewel room consist of six or eight different sets, of the first class, and are not to be surpassed in all Europe. Most of the gems, including the famous green diamond, were purchased during the reigns of Augustus II and III. This unique green brilliant weighs 40½ carats, and is in close proximity in the case to yellow and pink brilliants scarcely less remarkable in size and splendor. A garniture of rose diamonds, forming part of these crown jewels, consists of thirty waistcoat buttons, thirty coat buttons, four shoe and knee buckles, a clasp carrying a rose of twenty-six and seven-eighths grains, and epaulet with a diamond of sixteen and five-eighths grains, and a sword, the hilt of which sparkles with 780 roses. The largest Bohemian garnet in Europe, forty-six and three-fourths carats in weight, adorns one of the orders of the Golden Fleece here exhibited.

A CONVENIENT ARM CHAIR FOR THE LAME.

THIS chair rests wholly upon the five wheels; it will be remarked that it must necessarily move when the wheels are revolved, but must follow the direction that the wheels take.

In the construction of this apparatus motion must be given only to the two principal wheels, BB, for the two, CC, serve properly only for holding the chair in equilibrium, and the function of the one marked D is only to cause it to revolve more accurately. The necessary motion is given to the two principal wheels in the following manner:

These wheels, B B, being toothed on the face, are

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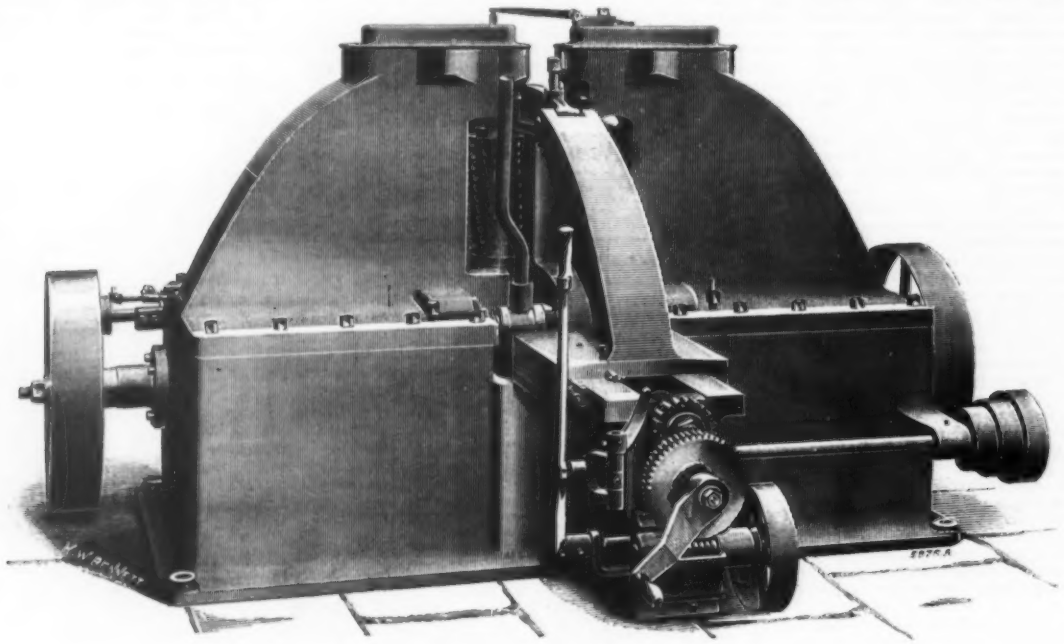
A CONVENIENT ARM CHAIR FOR THE LAME.

actuated through the pinion, E, and the spindle, F, by the winches, G. Thus, when you are seated in the chair, and turn the winches with your hands, you necessarily revolve the wheels, B, and cause the chair to move. If you wish to move forward, you turn both winches at the same time outwardly. If you wish to move backward, you turn them inwardly. If you wish to move to the right or left, you turn your winches unequally, and more or less, as may be necessary. And, finally, if you wish to turn upon a point, you have only to revolve the same winches in opposite directions.

Other conveniences that are in use for the service of the sick may be added to the chair, such as rendering the back movable so as to make it incline more or less, and providing it with a small table, desk and foot rest. Provided that this apparatus be made by a good workman and that the correct proportions that ought to exist between the wheels, B, the pinions, C, and the winches, G, be observed, you will need to effect but a slight stress to cause it to move, and you may even do this with two fingers. The invention of the wheel, D, is one of the most curious features of this apparatus, and its arrangement serves to greatly facilitate the operation of it. This engraving is reproduced from Recueil d'Ouvrages Curieux de Mathematique et de Mecanique, published IN 1733.

MILLING MACHINE FOR TEST SPECIMENS.

WE illustrate herewith a milling machine built by the well known Testing Machine Company of Riehle Brothers, Philadelphia, Pa., to meet the demands of rolling mills, railway shops, boiler makers, bridge builders, etc., for the rapid and accurate preparation of test specimens. The cutters are of the spiral type, being 6 in. in diameter and 12 in. long. They are arranged with their axes vertical and driven from each end. The prime driver is a bronze worm gear under each head carrying cutters driven by one worm shaft of cast



TEST PIECE MILLING MACHINE.

or tool steel. The worms are right and left, so that the thrust is self-contained. The specimen carriage slides at right angles to the bed similarly to the cross slide of a lathe. In it are placed specimens 18 in. long by 3 in. wide, roughly sheared. A clamp bar hinged to the carriage is brought into position and secured by a pin on the free end. In this bar are two clamping screws, which are screwed down upon the specimens to hold them rigidly in position. The heads carrying cutters are connected by right and left screws, and can be brought together or separated by moving a lever at the front of the machine. In working the cutters are fed inward to the width required for the specimen; the cross feed is then thrown in, and when the desired length is reached, the feed is automatically tripped. The whole machine is built in a manner to resist with no appreciable vibration the very severe duty it has to perform.

The machine shown was illustrated and described in a recent issue of the London Engineering.

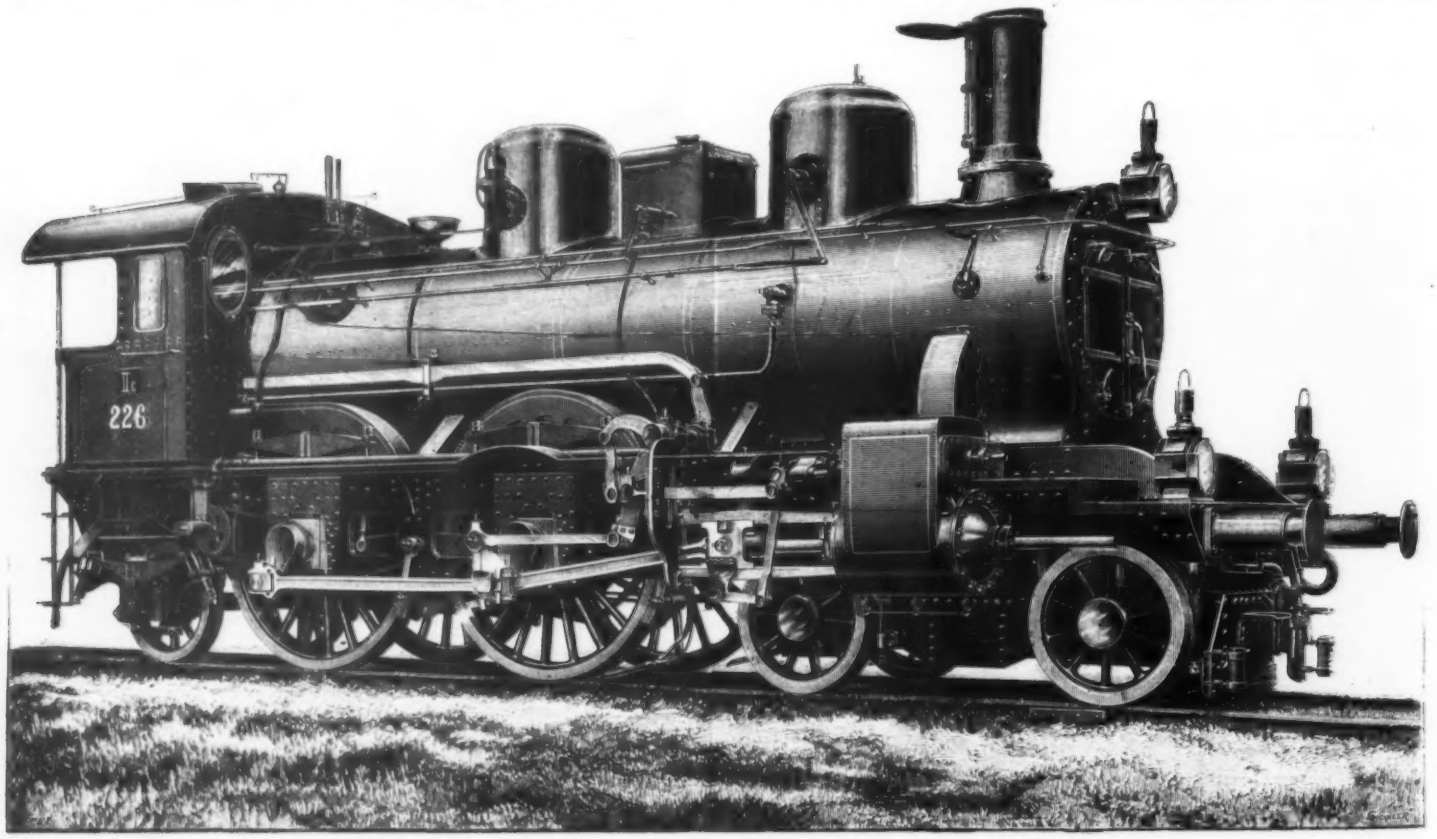
LOCOMOTIVE ENGINES ON THE AUSTRIAN STATE RAILWAYS.

WE illustrate herewith a passenger engine for the Austrian State Railways. The type has been so successful that, with considerable modifications, it has been repeated, and four new classes of engine have been recently supplied by the Neustadt Locomotive Fabrik for the Austrian State Railways and Kaiser Ferdinand North Railway. These engines are —(1) a compound express engine on the Goldsdorf system, said to have attained a speed of 85 miles an hour with perfect safety; 2, a compound express engine on the Kaiser Ferdinand North Railway; 3, a compound goods engine for the Austrian State Railways, intended to haul trains of 500 tons up grades of 1 in 100 at 15 miles an hour; and 4, a compound goods engine for the Kaiser Ferdinand North Railway.

We illustrate this week a locomotive of the second type named. It is working heavy traffic on the Kaiser Ferdinand line. This is a private line under state management, carrying the heavy Alpine traffic. The gradients are severe and the curves sharp. The boiler pressure is 195 lb; the diameter of the boiler barrel, 57·8 in.; heating surface of fire box, 142 square feet; of tubes, 1686 square feet; grate area, 31 square feet; diameter of cylinders, 18·5 in.; stroke, 24 in.; weight in running order, 60 tons; empty, 54 tons. We are indebted to London Engineer for the particulars we here record concerning the engine.

TESTS OF A CONCRETE AND WIRE FLOORING.

CONCRETE and wire flooring is being laid in several new business blocks now in course of erection in Providence, R. I. The object is to allow of greater span between the floor beams than is practicable with brick jack arches. Across the floor beams are stretched small wire cables, each composed of two galvanized wires twisted together. Round bars are then laid across the cables parallel with the beams and half way between them. Forms or centers are placed under the cables, and a composition consisting principally of plaster of Paris and wood chips is poured on, the cables thus being embedded in the concrete mixture, which solidifies in a few minutes. The vertical part of the concrete inclosing the floor beams is supported by wire netting passed around the flanges of the beam. If a flat ceiling is required, iron bars are laid across the bottom flanges of the beams, over which wire netting is placed, and a thinner layer of the composition is poured over this, leaving an air space between the floor and the ceiling. The strength of this material was recently tested. Fifteen inch I beams, 7 ft. apart, had their flanges protected by a composition coating 1 in. thick. The composition filling between the beams was 5½ in. in thickness. The cables, made of two strands of No. 12 wire, were continuous over six spans, and were secured at the ends to loops of heavy wire hooked over the top flanges of the beams. The cables were spaced 1½ in. apart, and their deflection in each was regulated by an iron bar ½ in. square. The weight of the floor was 24 lb. to the square foot, and it was designed to carry a live load of 170 lb. to the square foot. The length of the piece of floor tested was 12 ft. parallel with the floor beams, and parts were cut out, leaving four sections 7 by 5 ft. in adjacent spans to sustain the weight. The weight of 155 lb. falling 6 ft. went through the floor at the eleventh blow. The same weight falling 10 ft. went through at the fourth blow. No. 2 section was tested by loading the half span up to 100 lb. to the square foot, giving an eccentric loading, but when the weight was removed the floor returned to about its original position. Section No. 3 was tested by a uniform loading up to 700 lb. per square foot; the floor deflected $\frac{9}{16}$ in. at the center, but returned $\frac{7}{16}$ in. when the load was removed. Then the section was reloaded to 1,500 lb. per square foot—nearly



EXPRESS LOCOMOTIVE, KAISER FERDINAND NORD BAHN.

27 tons, on an area of 7 by 5 ft.—and some of the filling was destroyed, but none of the pig iron weights were forced through the floor, and none of the wires broke. A hot fire was kept under section 4 for an hour. The temperature of the beams was increased 2 deg., and water from the fire hose was turned on the top and bottom of the filling, none breaking loose. Next morning this section was uninjured by a load of 1,000 lb. per square foot.—The Metal Worker.

GASOLINE, ELECTRIC AND PETROLEUM CARRIAGES.

IN briefly describing, in a previous number, the automobile novelties of the fourth Salon du Cycle, we noted the success of the phaetons, and promised to describe those that had been submitted to street experiment, and also the Darracq electric coupe. We shall now keep our promise by reproducing, from photographs, some of the types of pleasure and traveling vehicles, and by giving fuller details as to the electric carriage, which constitutes a sensational novelty in the almost unexplored domain of automobilism.

FIG. 1.—THE MOREL PHAETON.

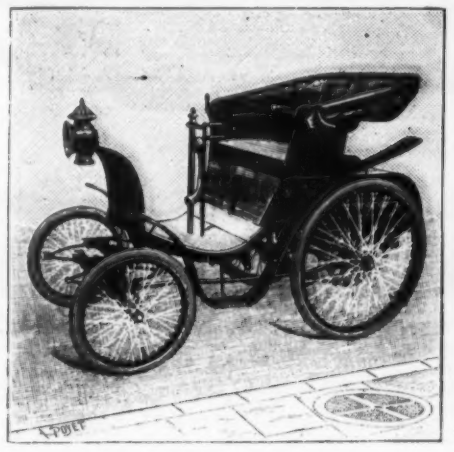


FIG. 2.—THE RICHARD PHAETON.

All these carriages have been put to the test, and we have seen all of them run under more or less favorable conditions. We cannot say as much of a goodly number of other horseless vehicles shown at the Salon du Cycle, and it is rightly that a demand is made for the formation, at future exhibitions, of an experimental track that shall be moderately rough, in order to allow visitors to appreciate the real value of the vehicles otherwise than by the seducing aspect of their handsome carriage work.

The Morel Phaeton.—The evolutions of this phaeton at the inventor's stand rendered it popular among the visitors. This little quadricycle weighs but 265 pounds, and is capable of carrying two persons upon moderately level roadways. It is the type of pleasure carriage for excursions of a few hours on spring or summer days.

In its construction we find the majority of the mechanical arrangements that have made Captain Gerard's folding bicycles a success. The motor, which is arranged under the seat, is identical with that of the De Dion & Bouton bicycle, which we have already described. Mr. Morel has merely added to it a change of speed consisting of an intermediate transmission formed of two cone pulleys connected by a belt. The latter, which is shifted upon the cones at will, permits of varying the speed between two extreme limits, according to the difficulties of the road. The steering is effected by means of a bicycle handle bar, which is placed to the left when the carriage carries two persons and in the center when it carries but one.

The vehicle is very elegant, but we fear that it is rather light for carrying two persons upon a road that is not any too good, and that the motor is inadequate for the service required of it, since pedals have been done away with. The aid that might be afforded by human strength can therefore not be relied upon. Experience will teach us whether or not these fears are exaggerated.

The Richard Phaeton.—Among the numerous types of phaeton shown at the exhibition, the one presented by M. George Richard (Fig. 2), attracted particular attention by its harmonious proportions, and by the clear impression of a just medium between the pleasure, traveling and racing carriages that have made the success of other manufacturers. This phaeton, in running order, weighs a little less than 650 pounds, and is capable of affording a run of seventy-two miles without a renewal of the supply of gasoline. It is actuated by a motor of four periods of the Benz system, with electric ignition, and well known to our readers. We have had an opportunity of taking a run in Paris in this vehicle in very bad weather and in crowded thoroughfares, and have found that the maneuvering of it is very simple and easy. As the entire weight is supported by the hind carriage, a woman or child can lift the fore carriage and cause the vehicle to make a half turn in situ, in case such a maneuver should be necessary in order to get out of a bad fix.

Without presenting any great novelty, the Richard phaeton appears to us, by its proportions and its arrangements of detail, to realize the type desired by the tourist who wishes to go everywhere, but who is not, however, afflicted with the mania for speed (a complaint in fashion among scorchers), and who is content with fifteen miles an hour on a level road.

The Mors Carriage.—The horseless carriage exhibited by M. Mors, by its aspect, weight and size, takes a place between phaetons and carriages, but more closely approaches carriages properly so called. It is the vehicle of tourists who are in a fair way of becoming afflicted with a mania for speed. It is mainly characterized by the arrangements of the motor and the mode of ignition. The motor has four cylinders arranged in pairs, and inclined at right angles with respect to each other in each pair. The crank pins upon which the pistons of each pair of cylinders act are in opposition. It results from this combination that the driving shaft receives two impulsions per revolution, that one of the cylinders operates by compression while the other is producing its useful effect, and that the motive couple is sensibly constant, and this almost completely suppresses the jarring characteristic of gasoline motors at a stoppage when the transmissions are thrown out of gear. The ignition is effected in each cylinder by utilizing the extra breakage current of an inductive circuit supplied by a very light accumulator employed solely for setting the motor in operation. As soon as the latter is in motion, the current necessary for ignition is furnished by a small dynamo of a power sufficient to prevent any failure to ignite. The vehicle, which, like the preceding, is provided with pneumatic tires, is very comfortable, and, owing to the power of the motor and the supply of gasoline that it carries, permits of making long trips at speeds that may reach and even exceed fifteen miles an hour.

M. A. Darracq's Electric Carriage.—We here leave the domain of the light vehicle in order to enter that of heavy ones—even very heavy ones, since the electric coupe weighs more than a ton and is capable of carrying but two persons in addition to the driver. This inconvenience, which constitutes one of the greatest objections that have hitherto been urged against the electric carriage, is counterbalanced by so many advantages that we persist in believing in its ultimate success, and that, too, in the near future, for locomotion in the interior of large cities, everywhere where the recharging of accumulator batteries presents no difficulties.

Gasoline will be reserved for traveling and business vehicles, while electric energy will actuate hacks and gentlemen's carriages in all cases in which economy is preferred to the luxury of a handsome team of horses. But this is not the moment to revert to those general considerations so often developed in these columns, and we must confine ourselves at present to a description of M. Darracq's new vehicle, which holds a place between a coupe by the general form of its body and a cab by the position of its driver. The body rests upon springs mounted upon a very rigid frame of steel tubes, and the latter in turn rests upon the axles of four wooden wheels provided with rubber tires. The steering is done through a long lever that passes over the roof of the carriage and acts upon the front wheels, which are mounted upon what is called a "broken" axle.

FIG. 3.—THE MORS CARRIAGE.

FIG. 4.—DARRACQ ELECTRIC COUPE.

The carriage is brilliantly lighted by two electric lanterns arranged on each side, a third in front and in the middle and a fourth in the interior. These lanterns are lighted at will by pressing a button placed in the interior of the carriage.

The electric energy is furnished by a battery of forty Fulmen accumulators arranged in two boxes, one of which is placed in front of the other, in the back of the carriage. These accumulators, which are invariably coupled in tension, have a capacity of 125 amperes hour at a normal discharge of twenty-five amperes; but such discharge may be notably exceeded in startings and in ascents. The weight of the battery is 880 pounds. The charge of the accumulators requires a final potential of 100 volts, at the rate 2·5 volts per element. This charge can therefore be effected without much loss upon distributing lines at 100 volts.

The current furnished by the accumulators actuates a four pole electric motor excited in derivation with a doubly wound armature. The commutator, which is maneuvered by the driver, and is combined in a manner analogous to that of the controllers of electric tramway cars, automatically effects, in the necessary and desired order, all the connections between the resistances of starting, regulation, speed and coupling of the armatures in tension or derivation for starting, putting on the brake, or stopping, without the driver having anything else to do but turn the handle in one direction or the other. A special reverser permits of effecting a running backward when that becomes necessary.

In order to prevent jerks upon starting and the excessive and abnormal discharges that the starting might produce, there is interposed between the axles of the wheels and the control of the differential a series of springs which, upon being compressed, give the motor time to get under way before the slightest displacement of the carriage. The resistant couple is null and increases progressively with the compression of the springs. Owing to this arrangement, the accumulators are well under control and the starting takes place almost insensibly.

The stoppage is generally effected by recuperation. In fact, if the motor is excited to a maximum and the two armatures are mounted in tension, it suffices that the carriage shall run at half speed in order that the counter electromotive force of the motor may exceed that of the accumulators. The motor then operates as a dynamo. It recharges the accumulators and usefully recuperates the energy, instead of wasting it in friction upon the tires and the blocks of the ordinary brake. A more energetic action is obtained by closing the armature in short circuit, while at the same time leaving the inductors excited. The passage from running to stopping can be effected only by passing through the intermediate positions that correspond to the two methods of putting on brakes electrically. Every stoppage therefore furnishes an elementary recuperation. In case the circuits are accidentally broken, a purely mechanical safety brake maneuvered by the foot assures a quick stoppage; but this is used only in cases of urgency.

The 880 pound battery permits of obtaining, without recharging, an effective run of five hours, at a speed of about six miles an hour, which is quite sufficient and often excessive even in the interior of cities.

With the possible and anticipated progress in the capacity and discharge of accumulators, it will be possible to reduce the weight or to slightly increase the speed and duration. As soon as a run of forty-eight miles and a mean speed of eight miles an hour are reached (and these are already nearly attained), the electric carriage will satisfy all reasonable exigencies, and will be able to occupy a place in the front rank of practical automobile vehicles in large cities. M. Darracq's cab coupe is one of those that have best allowed us to get a glimpse of that near future so full of promise over which the managers of central stations of distribution of electric energy are already rejoicing. In fact, to sell the current up to midnight for lighting and from midnight to noon for the recharging of electric carriages is the dream of to-day and the reality of to-morrow.—La Nature.

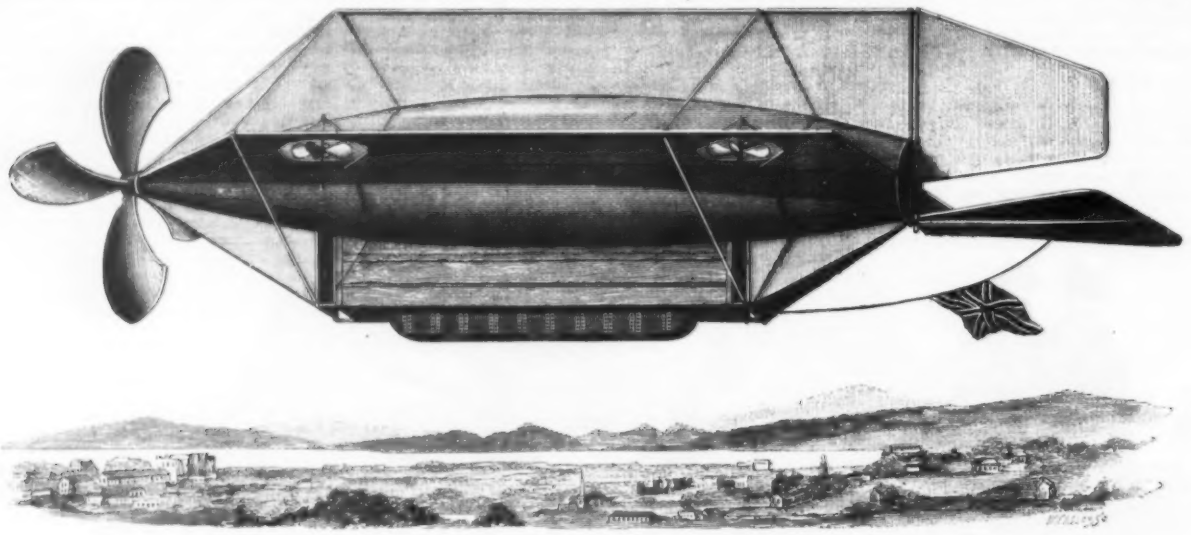
THE MOTOR CAR IN EXCELSIS.

THE Engineer, of London, gives, under the above caption, an interview of a correspondent with Mr. E. J. Pennington, who has recently established himself in England. The interview is entertaining, but it is apparently not written in an altogether serious vein. Space forbids us to publish the entire interview. The writer says:

Soon my attention was attracted to a framed design upon the wall, representing what my uninitiated eye at once told me was a flying machine. "What is it?" I asked. "That's my aerial torpedo that I want to tell you about," said Mr. Pennington, and when seated once more in his sanctum, he told me about it.

"I know people think me a man of great ideas and little practice. They may think so; I can't worry my head about them. But when an intelligent man like you"—I assumed an intellectual frown—"comes to me, I am only too delighted to tell him all I can about what I am actually doing. Now, here is the pass book of the Aerial Torpedo Syndicate, Limited"—I observed—"You see there is a balance of £15,000 to its credit"—I scrutinized—"I didn't want a syndicate. But several gentlemen wanted to become practically interested in the invention, and I agreed to its formation. You know what Mr. Maxim has been attempting to do; I

was at this business years before Mr. Maxim, and I'm telling you what I have done. This picture is from the photograph of an actual machine. First of all, the whole thing is made to weigh nothing, by means of a cigar-shaped bag of hydrogen gas. It carries an 8 horse power Kane-Pennington four-cylinder motor. There



THE PENNINGTON FLYING MACHINE.

are four horizontal air propellers, revolving in planes extending either side of the gas bag, and two vertical propellers at either end of the torpedo. All are worked by the motor. The horizontal propellers are connected electrically with a barometer, which is carried so that a given altitude may be sustained. The governing plane in the rear, constituting the rudder, has electrical connection with a compass, and the vertical propellers have an electrical reversing apparatus. Three charges of dynamite are carried, whose dropping can, of course, be timed.

"Now, let us suppose two European countries were at war. All that the general of the army who possessed my torpedoes need do is to get a hundred of them as near the enemy's capital as convenient. By calculating the distance, allowing for the wind, he can arrange matters so that they will get somewhere near the destination he intends them for, and he times the charges accordingly. Now he starts 100 of these off. If a quarter of them get anywhere near the capital, and drop their dynamite, that city is doomed to annihilation. The inhabitants can do nothing to defend themselves. Even if they hit them by shooting at them, they can only bring the dynamite down on their heads a little bit sooner, and it explodes all the same."

Here I was silent for a while, and then I smiled as I observed the flag that the torpedo in the woodcut was flying, and the beautiful emblematical device of "Peace" on Mr. Pennington's desk. "Yes; there's the British flag. And, so far, I've only had dealings on this subject with an Asiatic government—the Japanese. And I'm actually under contract to supply them with a number. The syndicate will not exist for nothing, I assure you."

Then my eyes fell upon a picture representing what I should have described as a small battery on wheels, but which Mr. Pennington called his "war autocart." This, he told me, was a quadricycle driven by a 16 horse power motor. It is completely surrounded by steel armor plating to a height of nearly 3 ft. The tires of the wheels are of solid rubber 4 in. in diameter. It carries two quick firing guns and 5,000 rounds of ammunition for each gun. In the ordinary Maxim gun each shot is fired successively by the recoil of the preceding one. The guns in the "war autocart," however, are fired by the motor, and do not depend on the recoil. When once the machine has taken up a favorable position, the power of the motor is simply transferred from the wheels to the guns, which continue firing even if the gunners are shot down. But the men can always shelter behind the armor plating. I understood from Mr. Pennington that a specimen of this machine was in process of construction.

And here I shook hands once more. Confiding me again to the care of Mr. Carse, Mr. Pennington said, "Now, I don't want you to say anything but what you have seen with your own eyes, and what little I have told you that you find you can believe without stretching a point. Anyway, you've had it first hand, and I don't think you'll find me the sort of man to go back on what I've said."

Now, although Mr. Pennington's presence and expression are necessarily attended by conviction, I could not forbear from asking Mr. Carse, as I took my leave, whether that flying machine really existed or not. Appreciating my incredulity, Mr. Carse replied, "Why, yes. Mr. Pennington has been up in it!" I suppose I shall have to believe it.

[Continued from SUPPLEMENT, No. 1109, page 17730.]

ROTARY PUMPS AND ENGINES: THEIR ORIGIN AND LATER DEVELOPMENT.

REFERENCE has already been made to Lord Cochrane as an industrious inventor in the field of rotary engines. In his endeavor to produce a practical machine of this type he displayed remarkable ingenuity, and the wide variety of mechanical combinations which he employed bears tribute to his versatile skill. To appreciate the zeal with which engineers worked on the rotary engine problem, we must remember that the reciprocating engines of those early days were very cumbersome affairs, being both heavy and bulky in proportion to their power. The rotary engine seemed to offer a speedy solution of the difficulty, as it was evident to these early experimentalists that, relatively to its power, it would be exceedingly light and compact. These are facts which, in these days of the perfected, high speed, automatic, reciprocating engine, we are apt to forget. The rotary engine epoch marks an important stage in the history of the development of the steam engine. All the possibilities and limitations of the type were proved to demonstration, and the field of invention was proportionately narrowed down to the development of the present standard type of engine.

Fig. 10 represents a rotary engine, designed by Lord Cochrane, over half a century ago. It was provided with an eccentric piston, a, which was keyed eccentrically upon the driving shaft, the latter being concentric with the cylinder. The piston crank, a (as this part might correctly be termed, since it performs the work of both these parts of the common steam engine), worked in sliding, steamtight contact

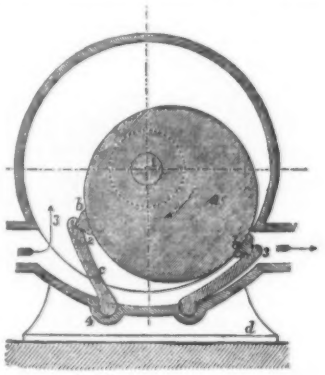


FIG. 10.—COCHRANE STEAM ENGINE.

with both the periphery and ends of the cylinder. There was one inlet and one exhaust for the steam, and midway between them a very ingenious arrangement of swinging abutments was provided. This consisted of two transverse diaphragms, c, extending across the cylinder, with their lower edges working in half round pockets, 4, in the cylinder wall, and their inner edges bearing upon gun metal packing pieces, b, which were kept in steamtight contact with the piston by the pressure of the steam upon the abutments, c. Fig. 10 is a striking instance of both the mechanical ingenuity and the mechanical weakness of these early rotary engines; the weakness consisting in the number and area of the surfaces that require steamtight packing.

Fig. 11 represents a type of rotary engine which has

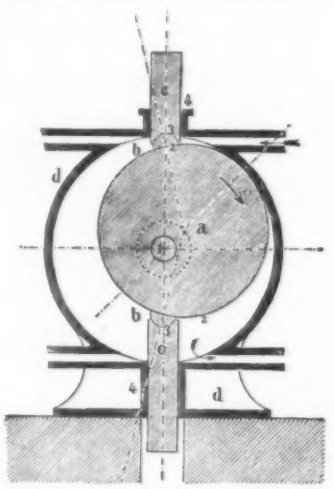


FIG. 11.—NAPIER STEAM ENGINE.

been very popular with inventors, and has been the subject of frequent reinvention. In its simplest form it was originally invented by Bährens in 1847, who provided only one inlet and exhaust and one abutment. In 1851 D. Napier provided two sliding abutments on opposite sides of the cylinder and two sets of steam and exhaust ports. It will be seen that the piston, a, is eccentric, as in Cochrane's engine Fig. 10. The abutments consisted of two diaphragms, c, which worked through rectangular stuffing boxes on opposite sides of the cylinder. To secure a steamtight joint between diaphragms and piston, crescent-shaped half cylinders, 3, were interposed between the inner edges of the abutments and the piston face. Bährens closed his one abutment, which was placed on the top of the cylinder, by dead weight. Newton improved on this by placing eccentrics upon the driving shaft, 1, externally to the cylinder, and connecting them by suitable gear with the blocks. In this arrangement, however, he was anticipated by E. Burt, an American, whose patent, dated 1816, will be illustrated later in the present series of articles.

Fig. 12 introduces to the reader another type of rotary pumps and engines which has proved very attractive to

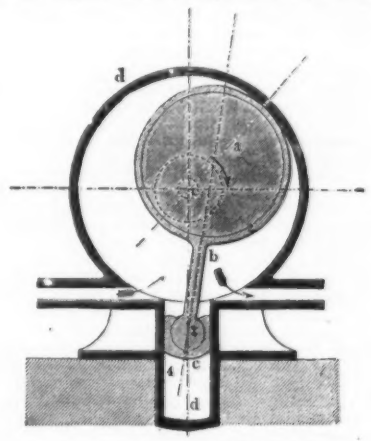


FIG. 12.—PATTISON PUMP.

inventors. It represents a pump patented in England by Pattison in 1857. By comparing this with the four machines, Figs. 13 to 17, which follow, it will be seen that they all have an eccentric piston and a diaphragm extension of the same, which slides in a recess cut across the periphery of the cylinder, and forms an abutment between the inlet and exhaust.

In the Pattison pump the piston is a hollow cylinder, 2, which rotates upon and is driven by the eccentric, a.

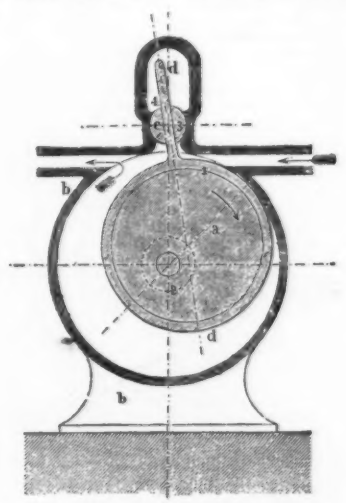


FIG. 13.—KNOTT PUMP.

A diaphragm, b, is formed integrally with the piston and extends downward to engage a rectangular block, c, by means of a cylinder-and-socket joint, 3, as shown in the

engraving. The block, c, is a rectangular prism which slides vertically in the chamber, d. As the shaft, 1, is rotated, the water is swept round in front of the contact point of the peripheries of piston, 2, and cylinder, d, and, being checked by the diaphragm, b, it is forced out through the discharge.

Half a dozen years later Knott patented in England the pump shown in Fig. 13. The chief difference between this and the Pattison pump is in the device for securing a watertight joint at the abutment. The entrance to the chamber which receives the diaphragm abutment is closed by a cylindrical block, c, which is slotted to receive the abutment. As the pump rotates, the abutment has a sliding and rocking motion through and about the center of block, c. These joints and the point of contact of piston and cylinder are made watertight, and the water is drawn in from one side of the cylinder and discharged from the opposite side.

In the blowing machine, Fig. 14, patented by Wedding, in Prussia, 1868, the driving eccentric, piston and swinging abutment of the former machines are formed

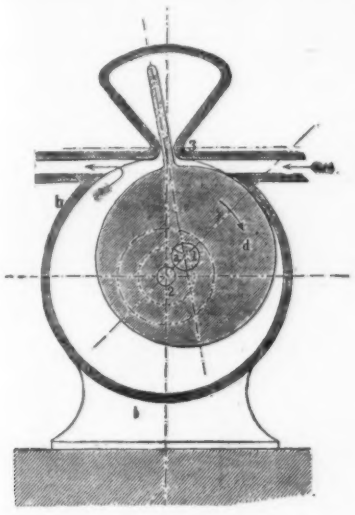


FIG. 14.—WEDDING BLOWER.

in one piece, motion being transmitted to it through the crankpin, a. The diaphragm works as in the previous machines in a chamber formed exteriorly to the cylinder, its cross section conforming to the area swept through by the diaphragm. It was claimed by the inventor that, as the air pressure was never high in this type of machine, the rather loose character of the joint at 3 was immaterial. It will be noticed that in this machine and in the Pattison and Knott pumps the air or water is free to pass from the suction to the delivery pipes when the piston is at the top of its stroke, and consequently no effective work is done during a small part of the revolution near this point.

The pump shown in Fig. 15 was the invention of Lord Cochrane, and bears some similarity to the steam

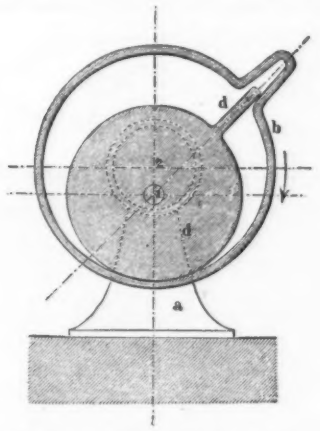
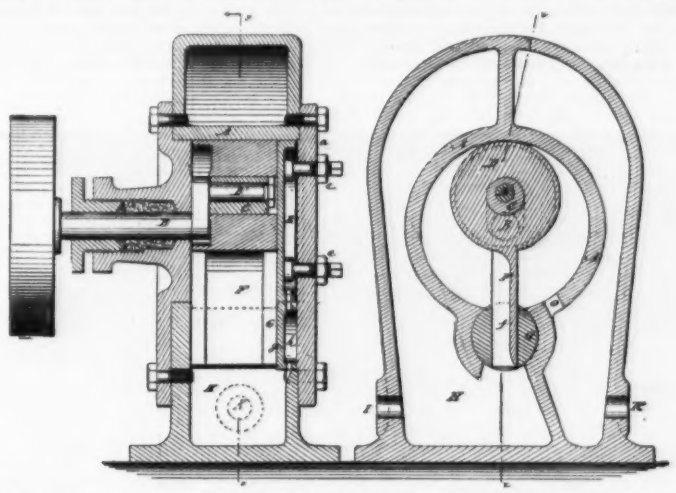


FIG. 15.—COCHRANE PUMP.

engine designed by the same inventor and illustrated in Fig. 9 of the preceding article. In this case the cylinder, b, rotates about the center, 2, in the direction indicated by the arrow, the interior cylinder, d, with its diaphragm rotating about center, 1. Owing to the relative eccentricity of the two cylinders the diaphragm slides in and out of the pocket which projects from the wall of the outer cylinder, the water being drawn in and expelled by the enlargement and reduction of the volume of the spaces on each side of this diaphragm.

Figs. 16 and 17 represent, in fuller detail, an American rotary engine or pump which was patented by W. E. Bartrum and H. C. Powell in 1878. In this machine the piston, D, was placed eccentrically within the cylinder, A, within which, like the Pattison, Knott, and Wedding machines, it worked with a rotary swinging motion. Fig. 16 is of special interest as showing the ingenuity which inventors displayed in the effort to compensate for the rapid wear which takes place in all rotary engines. The crank shaft, B', was provided with a small eccentric, C. When there was a slackness between the piston and the cylinder, a cap, a, on the side of the cylinder was removed, and by turning the eccentric, C, the piston was adjusted to take a closer bearing against the inner surface of the cylinder, A. To take up lateral wear a sliding plate, E, was provided at one end of the cylinder, A, set screws, e, being provided to take up the slackness and prevent leakage of the steam. The abutment arm or diaphragm, F, was carried through a cylindrical rocking joint, G, through which it had a longitudinal sliding motion. An induction port, f, was formed through F, and led in from the cavity, H, which was filled with live steam or water



FIGS. 16 AND 17.—BARTRUM AND POWELL ENGINE OR PUMP.

through the passage, T. On the opposite side of the abutment to f was an exhaust port, o, which led to an exhaust or delivery pipe at K.

The steam engine shown in Fig. 18 was another of Cochrane's inventions. In this case the cylinder, a, is stationary, and has single induction and exhaust ports. A hollow cylinder, b, is placed eccentrically within a, and rotates upon axis, 2, the faces of the cylinders being in contact and forming an abutment at a point midway between the two ports as shown. The piston consists of a

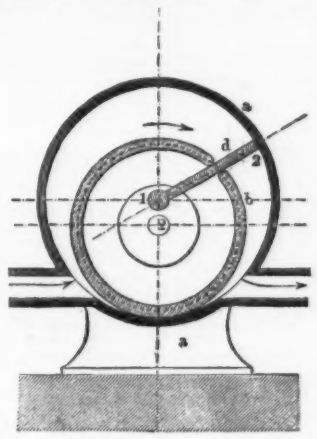


FIG. 18.—COCHRANE STEAM ENGINE.

rectangular diaphragm, d, which rotates about the axis of a with its outer edge in steamtight contact with the inner surface of a. The piston passes through a longitudinal slot cut across b, the edges of the slot sliding with a supposed steamtight contact upon d as the piston rotated. The weakness in this engine is the evident impossibility of keeping this sliding joint steamtight.

The rotary engine, Fig. 19, patented by Lamb in 1842 in England, was a thoroughly novel invention. The steam space in the cylinder was annular and was formed by two concentric cylinders united by a dia-

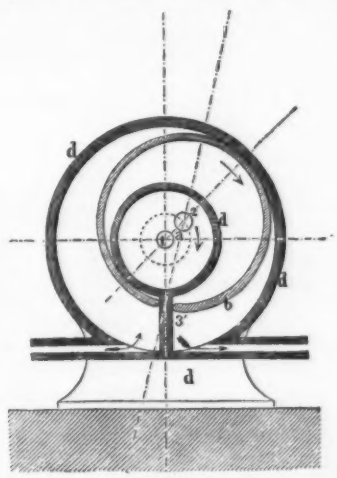


FIG. 19.—LAMB STEAM ENGINE.

phragm, 3', which formed the abutment and was located between the inlet and exhaust. The eccentric piston, b, was a hollow cylinder with a longitudinal slot which slid up and down the diaphragm as the piston traveled in its path in contact with the cylinder. Steam was admitted on both sides of the hollow piston. In the position shown in Fig. 19, the large space between piston and cylinder to the left of the abutment is full of live steam, and steam is also entering the small space between the inner face of the piston to the left of the abutment and the outer face of the inside cylinder, d. It will be seen from this arrangement that a leakage past the slot will not impair the efficiency of the engine.

In Fig. 20 we have another rotary steam engine by Cochrane. It had two pistons, d, which consisted of two diaphragms which were arranged to slide through the wall of a hollow cylinder, b, placed eccentrically within a, as in Fig. 18. The pistons worked through a cylindrical rocking joint, c, in b. The original design was made in 1831. A patent for a similar style of engine, but with one piston, was taken out by Hick in 1843, and by Lechat in 1866. In America, Root took out a patent in 1863, for a similar engine which made use of three pistons. A description, with illustrations

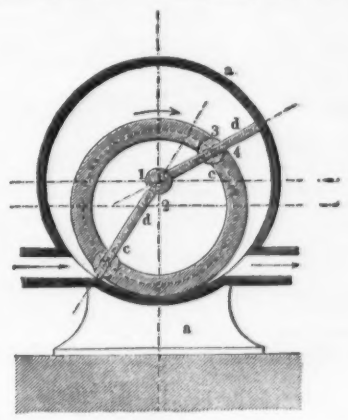


FIG. 20.—COCHRANE STEAM ENGINE.

of this engine, appeared in the SCIENTIFIC AMERICAN of January 31, 1863.

(To be continued.)

SOLUBLE SICCATIVES.

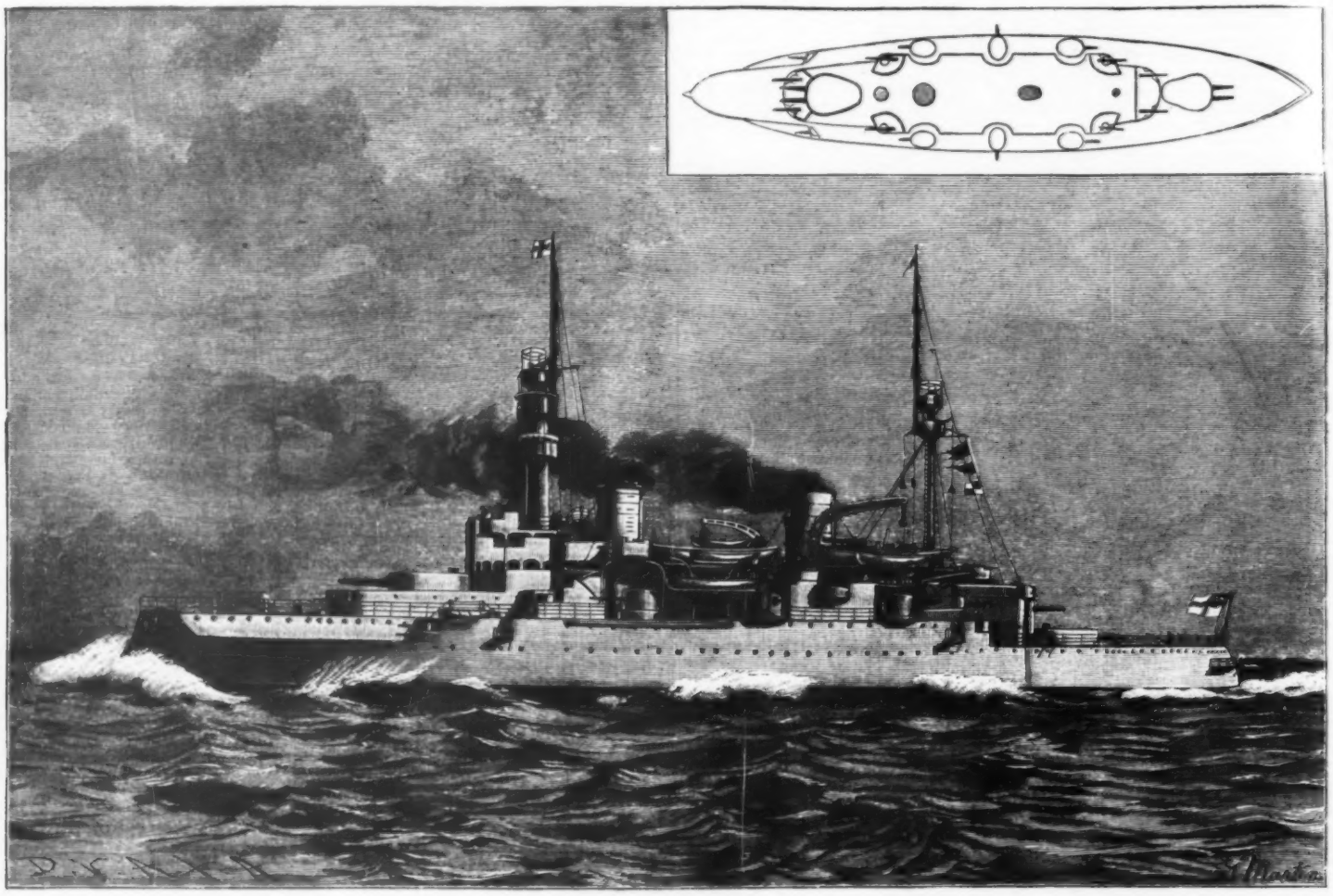
THE siccatives, substances which are to quicken the drying of varnishes, were introduced about ten years ago. They are soaps of lead and manganese, combinations with the acids derived from resins, linseed and other oils, also from stearine, etc. Their great recommendation is that, while the ordinary drying agents, the various lead oxides, dioxide of manganese, borate of manganese, require high temperatures, these substances can be dissolved in linseed oil or turpentine, and added in the cold, or can at once be admixed at the comparatively low temperature of 248° F. In either case, the operations are much simpler, more economical in fuel, and, what is most important, much safer than with the old way; there is practically no risk from overboiling and fire. The adoption of the new process has been slow; however, at present, the majority of varnish works apply the soluble siccatives. The hesitation was due chiefly to a want of confidence on the part of the practical men, which is not much to be wondered at, considering that the theory of varnish making remains a matter of controversy up to the present day. Granting the advantages, the varnish was said to be of inferior quality. There seems to be something in an objection which has recently been raised again, that the varnishes prepared on the new plan will dry all right at first, but not afterward. M. Weger is investigating this question, to which he refers in a long paper on siccatives, their theory and analytical determination, contributed to the Zeitscrift für Angewandte Chemie. So far as his researches go, the objection is not altogether unjustified, but the fault rests clearly with the lead, and not with the resin.—Trades Journals Review.

The following account of a remarkable process, published in the Wall Street Journal, should be of interest to electric railway men: Some time ago Mr. McKenna, one of the officers of the St. Paul road, devised a system for rerolling worn steel rails, so as to make them available for fresh use and as good as new rails. A contract has now been made to build a mill, which will be running by about June 1, and orders for about 30,000 tons of rails have already been promised. Under this process there is necessarily some diminution in the weight of the section, but there is an increase in length. Experiments tried with rails for the St. Paul road resulted in a reduction of the section from 66 pounds to 60. Of the rails delivered to the mill, however, 93·2 per cent. by weight were returned as perfect rails, and by length 103·1 per cent. were returned.

THE NEWEST VESSELS OF THE GERMAN NAVY.

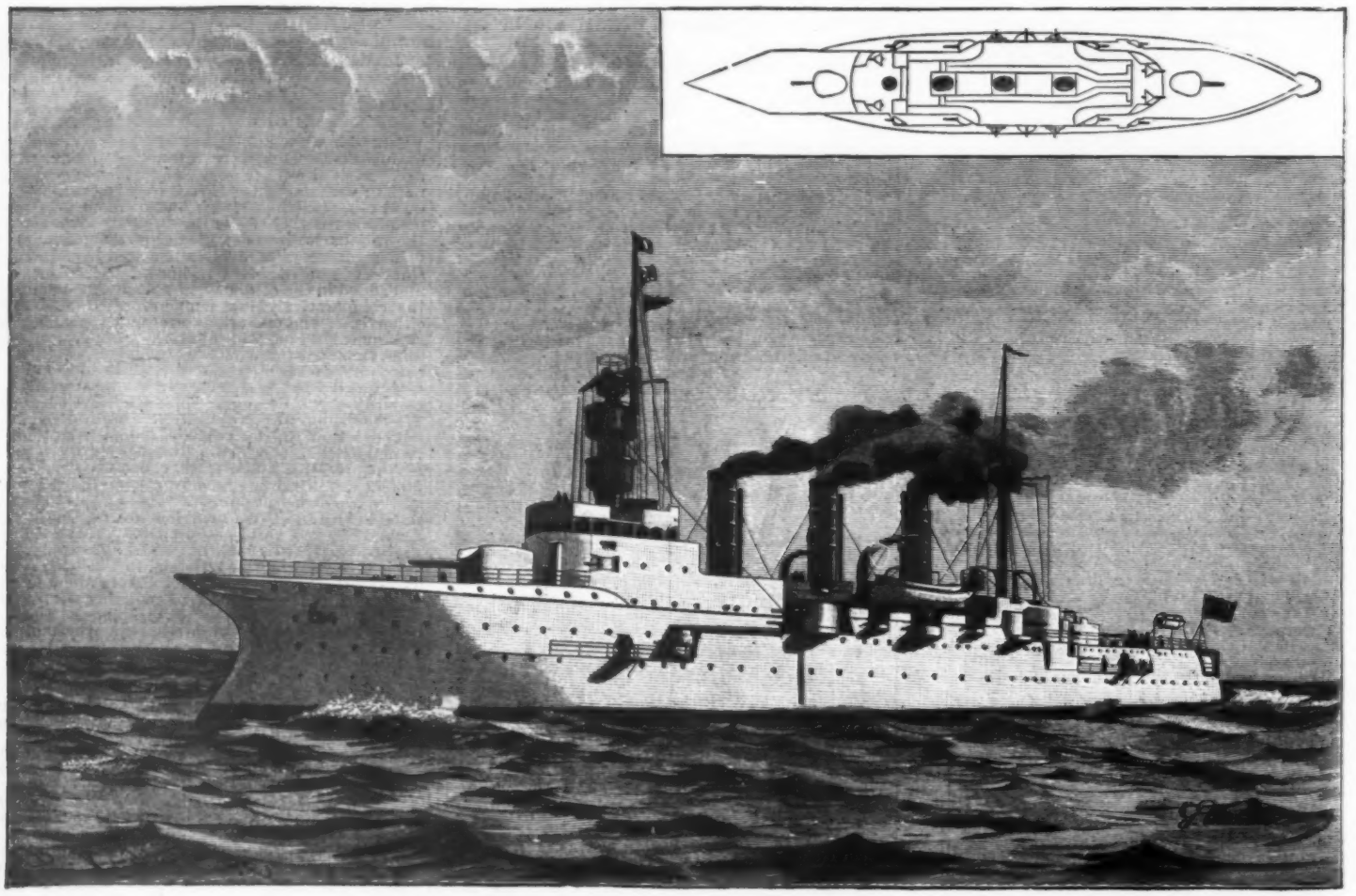
The Kaiser Friedrich III, one of the substitute vessels called for by the plan for the German navy, has recently been launched. It is a substitute for the Preussen, and is an armored vessel of the first class, being, in fact, larger than any other vessel heretofore included in the German navy. Its displacement is 11,130 tons, or 1,130 tons more than the Brandenburg class, formerly the largest in the navy. This vessel is 377 ft. long, 67 ft. wide, and has a draught of 25 ft. 9 in. and, like all modern battle ships, the Kaiser Friedrich III has a belt of armor that extends back over four-fifths of its length, so as to protect the engines and boilers. The material of this belt, like that of the rest of the vessel, is German steel; it is 150 millimeters thick at the end and 300 millimeters thick in the middle. The revolving turrets for the guns are covered with armor, some of which is 24 to 25 centimeters and some 15 centimeters thick, and certain parts of the deck are also

Deck Plan.



KAISER FRIEDRICH III (SUBSTITUTE FOR THE PREUSSEN).

Deck Plan.



SECOND-CLASS CRUISER K (SUBSTITUTE FOR THE FREYA).

THE NEWEST VESSELS IN THE GERMAN NAVY.—Drawn by Georg Martin.

protected in this manner from indirect shots. The characteristic feature of this new vessel is, however, the extraordinary strength of the armament, which includes guns of five different calibers, of which the four 24 centimeter guns are arranged, two in a turret, one forward and the other aft: the twelve 15 centimeter rapid loading guns are in casemates, and the 15 centimeter rapid-loading guns in revolving turrets. There are also, scattered over the vessel, twelve 8·8 centimeter rapid loading guns, all of which are protected by armor shields; and in the military mast and high deck house there are altogether twelve 3·7 centimeter Maxim guns and eight 8 millimeter guns. The torpedo equipment consists of two torpedo tubes at the bow, four broadside tubes and a tube at the stern, all 45 centimeters in diameter. The engines, which indicate 13,000 horse power, give the Kaiser Friedrich III the remarkable speed of 18 knots an hour, which is a greater speed than has ever before been attained by any battle ship in the German navy. The crew consists of 655 men.

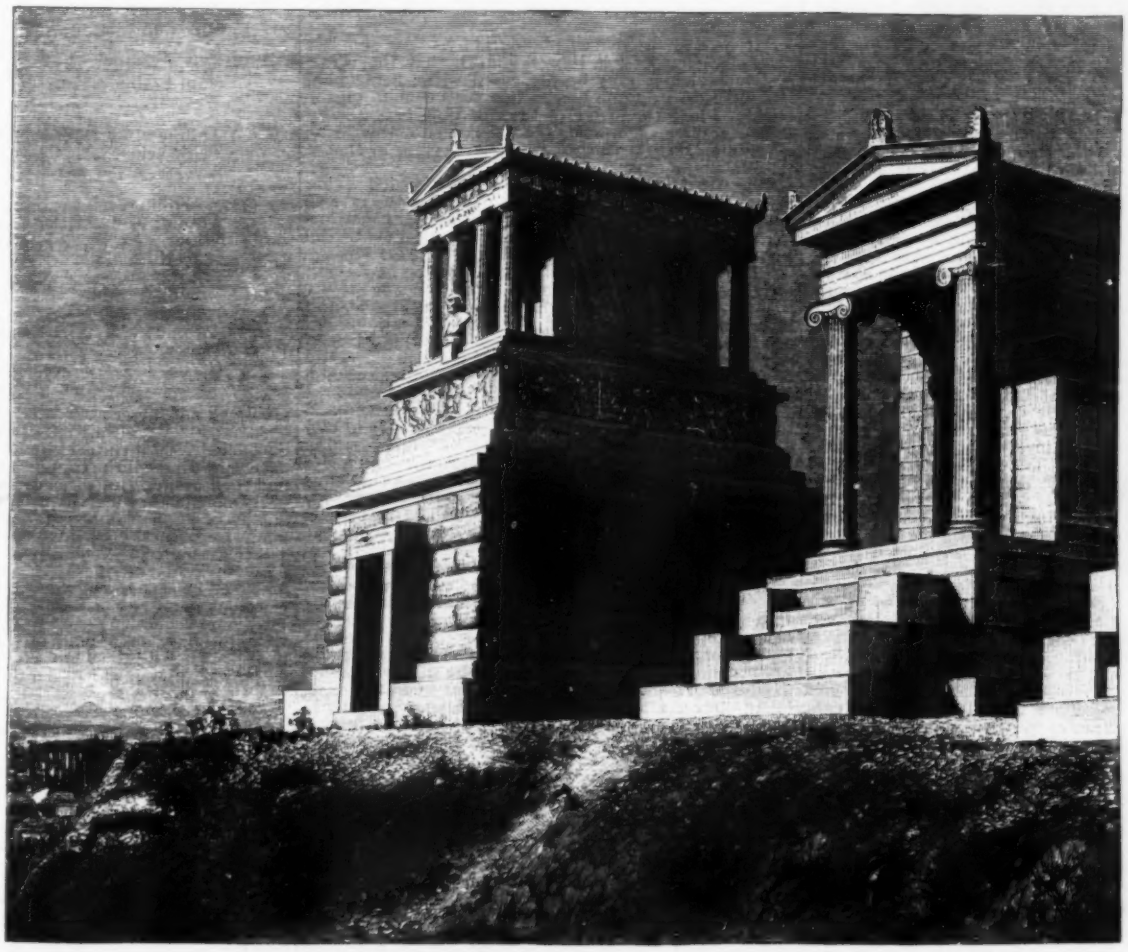
The cruiser K (substitute for the Freya), like the Kaiser Friedrich III, represents a new type in the German fleet. While the armored vessels have long been made without rigging, it is only within the last few years that corvettes and cruisers intended for foreign service have been provided with engines only, and the cruiser K, shown in our illustration, is one of these. The Gefion is similar, but is not so heavily armed, and has not the high miiitary mast. The substitute for the Freya is a slender vessel, being built specially for great speed, for it, like the other cruisers, is to be used in protecting the colonies. It is 344 ft. 5 in. long between the perpendiculars, and its entire depth from the upper deck is 37 ft.; its draught is 20 ft. 6 in. Although only about half as large as the Kaiser Friedrich III—5,630 tons—its engines, which indicate 10,000 horse power, fall very little behind those of the battle ship. Its characteristic features are the peculiarly shaped bow, the high casemate-like structure with the bridge, and the military mast. The latter can hardly be called a mast—"military tower" would be a more appropriate name, for it has nothing in common with a mast but its height. It is nearly as large as a smokestack, is hollow and contains stairs leading to the top and also the electrical conductors for the search light placed up there. The armament of the cruiser consists of two 21 centimeter L Krupp guns, that are located in revolving turrets, one forward and one aft; eight 15 centimeter and ten 8·8 centimeter rapid-firing guns in casemates and revolving turrets, and in the military mast four 8 millimeter machine guns, constituting a very strong armament for a cruiser of the second class. Below the water line there are two broadside torpedo tubes and one tube at the bow. The deck plans show best the arrangement of the artillery. The cruiser K can fire six guns forward at the same time, or eleven on each side; while the Kaiser Friedrich III can fire ten forward and twelve on each side. The plans for the two vessels were designed by the chief constructor of the German navy, Geheimen Admiralitatsrat Dietrich.—Ueber Land und Meer.

The foreign element in France includes 500,000 Belgians, 300,000 Italians, about 80,000 Germans, as many Spaniards and Swiss, 7,000 Americans. The number of Frenchmen living abroad is 517,000, of whom over 230,000 are in America, and about 210,000 in Europe.—Revue Geographique Internationale.

SCHLIEMANN'S MAUSOLEUM IN ATHENS.

FEW burial places in the world are as beautifully situated as the Greek cemetery at Athens; only those of Paris and Naples and the Mohammedan graveyard at Constantinople, or rather on the Asiatic shore above Scutari, can be compared with it in this respect. At Père-la-Chaise the eye wanders over the sea of houses that constitutes Paris; from the Campo Santo at the foot of Vesuvius, the view of the blue Mediterranean with its bays and islands is most enchanting; and when standing in the cypress grove at Scutari the eye feasts on the beauties of the Bosphorus and the Sea of Marmora; but the location of the cemetery at Athens is unique, being, in the full sense of the word, classic. Lying as it does on a spur of the Hymettus, at the foot of the Acropolis, beside the Stadium and the pillared splendor of the Temple of Zeus, what can compare with it, and what matters it that this cemetery is poorer than those of Paris and the Italian campi santi in remains of illustrious men and in fine monuments? The comparatively young kingdom of Greece has produced and buried only a modest number of statesmen, warriors, artists and men of science, and the monuments in the churchyard at Athens cannot compare—in variety, richness, beauty and originality—with those produced by the chisels of Italian sculptors and which have made of the campi santi of Genoa, Milan, Bologna and other cities real museums of art; but its classical location is unapproachable.

The attention of the visitor is attracted specially by two magnificent marble structures in front of the graveyard, one of which is the mausoleum of Heinrich Schliemann and the other the tomb of a rich Greek.



SCHLIEMANN'S MAUSOLEUM AT ATHENS.—FROM A PHOTOGRAPH.

Schliemann, whose spade laid bare the tombs of so many kings at Mycenæ, chose to have a kingly grave. In 1883, seven years before his death, he gave to his friend Ernst Ziller of Dresden—government architect in Athens—an order to prepare a design for a monumental tomb. Ziller, who first as a pupil and then as a partner of the great Dane, Hansen, had attended to the practical part of the fine buildings (the Academy, University, Library, etc.) which ornament the Stadium Street of new Athens, had built for Schliemann the beautiful house on this street in which he passed the happiest years of his life and which is still occupied by his widow, and he wanted that his mausoleum should also be the work of his friend, so he attached the Ziller design to his will and set aside about $9,600 for its construction. Our engraving shows this noble design. The lower portion of the mausoleum is built of gray and the superstructure of white Pentelic marble. The chamber for the casket is lined with white marble decorated with Pompeiian designs; it is large enough to hold also the casket of his wife, who was a true helpmate in his work. Her bust is to be placed on the rear or west side of the tomb; Schliemann's bust stands above the wrought iron door between the Doric pillars of the temple-like superstructure, facing the east.

The lower portion and this superstructure are connected by a frieze about 2 feet high and 52 feet long, of white marble, on which is represented a continuous chronicle of Schliemann's achievements, with scenes from the Odyssey and from ancient history. The north side of the frieze represents Schliemann at work. He stands in the center of the relief with his wife near him reading from Homer; at the right and left are workmen placing the most important things discovered by Schliemann on wagons and carrying them away. In the composition of this wonderfully life-like frieze, Ziller asked the advice of Dr. Lolling, of the Archæological Museum, but the frieze itself is a fine piece of work by the sculptor Kanakis. On the metopes of the cornice are reproductions of different objects discovered during Schliemann's excavations. Schliemann had the inscriptions for the temple prepared during his life time by Dr. Rusopulos; he directed that the words, "To the Hero Schliemann" (in Greek) should be chiseled in the epistyle, and above the door of the mausoleum is a Greek distich, which sounds rather conceited, and which when translated reads about as follows: "I conceal the world-renowned Heinrich Schliemann. Imitate him who has done so much for mortals."

It is truly a tomb fit for a king, and this particular spot, at the foot of the Acropolis, from which the eye wanders over the plain of Attica and the Saronic Gulf with the islands of Salamis and Ægina and across the sea to Asia Minor and Troy, seems a suitable resting place for one whose spade let the sun in again upon Mycenæ, Tiryns, Orchomenus, and the Troy of his beloved Homer after it had been shut out for thousands of years.—Illustrirte Zeitung.

MAKING RUBBER STAMPS.*

THE process of making rubber stamps being very simple, and the materials and apparatus for carrying out the process being inexpensive, doubtless many would undertake this branch of business if the details of manufacture were well known. The secrets of rubber stamp making have always been carefully guarded, thus practically limiting the business to those who have learned the trade in the regular way. The instructions given below are based upon the actual practice of the best makers, and written after actual experience in the business.

The tools required for beginning the business are one or more fonts of regular printers' type, one or two chases, some printers' leads, and a small press. The chases are expensive, and as the type is only subjected to a moderate pressure, a cast iron chase may be used instead of one made of wrought iron, and even a wood chase may be made to answer, but this is not recommended. If a wooden chase is resorted to, it should be made from hard wood, such as oak or cherry, of 1¼ inch bars dovetailed together. If ordinary type is used, the chase may be ½ to ⅝ of an inch high. In one side and one end should be inserted two or more screws for clamping the type in the chase. Some printers' wooden furniture will be needed for filling in the chase around the type; leads also are used for this purpose and for spacing between the lines. In each corner of the chase a short ⅜ inch iron rod is inserted. These rods form a guide for the matrix plate, which is perforated to receive them, and between the matrix plate and the rods are placed short spiral springs, as shown in the engraving. These springs are designed to prevent the composition, of which the mould is formed, from coming into contact with the type before the screw of the press is applied. The iron matrix plate is of the same size as the chase, and is provided with two longitudinal ribs. The under surface of the plate, including the ribs, should be planed. The rods which form the guides for the matrix plate must project from the chase at right angles, and must be well fitted to the holes in the

* From the "Scientific American Cyclopedia of Receipts, Notes and Queries." Copyrighted, 1891, 1892, by Munn & Company. Right of republication reserved.

plate. The ribs of the matrix plate are ⅛ of an inch high.

Type setting is somewhat difficult for an amateur, but a little practice will soon give proficiency. The type, when set, reads backward, so that if it is desirable to see how the type will appear, a piece of print may be held to the light and viewed from the back side. When the form is made up it is placed in the chase and centered by means of the wooden furniture and leads, the leads being placed next to and between the rows of type. The form should be made up on a flat surface, such as a slab of marble or a level hard wood plank. As soon as the form is locked by means of the screws, the type is planed by laying over it two or three thicknesses of paper, placing on these a smooth, flat block, and tapping the block with a mallet. As soon as the surface of the type is leveled, the screws in the chase are again tightened, and the form is ready to receive the impression.

The type is now ready to receive the composition of which the mould is formed. The following is considered the best and most reliable formula for this

composition: Finely powdered soapstone, 1 lb. 3 oz.; best dental plaster, 1 lb.; fine powdered China clay (kaolin), 1 lb. These materials are mixed dry, and sifted through a sieve having a fine mesh. A quantity of the composition sufficient to form the mould is placed in a suitable vessel, and mixed with a solution formed by dissolving 5 oz. of dextrine in 1 qt. of hot water. This is to be used cold, and can be prepared in advance. Enough of the dextrine solution is added to the composition to make a thick dough a little stiffer than putty. It should be thoroughly but very quickly mixed and kneaded, and should be smooth and free from lumps. It is to be spread out upon the matrix plate so as to nearly cover the entire space between the longitudinal ribs; then, by means of a brass edged ruler, a straight iron bar, or even a table knife, the top of the composition is smoothed and made level, employing the longitudinal ribs of the matrix plate as guides.

When the composition is level with the longitudinal ribs and perfectly smooth, the type is well moistened with benzine, and the matrix plate bearing the coating of composition is placed over the top of the form, the rods before alluded to forming the guides for the plate, and the plate is allowed to rest upon the springs. Then the form, together with the matrix, supported above the type in the manner described, is put in the press, and sufficient pressure is applied to carry the matrix plate down so as to cause the composition to take a perfect impression of the type. The pressure is relieved, and the matrix plate is then removed and allowed to stand for about three minutes, when it is again put on the form above the type, in the manner before described, and then placed a second time in the press and again subjected to pressure, this time using a little more force. The distance to which the type penetrates the composition can be regulated by the printers' leads.

The press used may be purchased from one of the rubber stamp supply houses, or an ordinary letter press may be brought into use, but it is absolutely essential that the plates of the press be parallel. Presses which will answer every purpose can be frequently picked up at the junk shops for a mere trifle. Many substitutes for a press will suggest themselves, but in this, as in anything else, whatever is worth doing is worth doing well; therefore it is advantageous to procure the best tools and appliances on the start.

In any event the press must be capable of standing a heat of 250° F. without warping.

When the matrix is removed from the type the mould should be glossy in every part, and each letter should be clear cut and sharp. Small perforations are now made in the matrix, care being taken to not make them too near the impressions of the type. These are for vents for the escape of moisture. The plate is now heated in an oven for about an hour and a half. The mould is sometimes apt to crack, but this is generally due to too much heat or to a lack of homogeneity in the composition. When the mould is thoroughly dry its face is smoothed with fine sandpaper, and the dust is blown from the letters by means of a bellows.

The rubber used in making stamps is especially prepared by manufacturers for this purpose. It is pure unvulcanized rubber prepared in a special way for vulcanization. Much of the trouble of amateurs in making rubber stamps arises from the use of vulcanized rubber, or of a wrong composition or thickness. The material should be obtained from reliable dealers in rubber stamp materials or from the rubber manufacturers who make a specialty of it. It is purchased in sheets which are readily cut to the required size; they should be a little larger than the impression of the type.

To prevent the adhesion of the rubber to the mould, before the rubber is applied it is thoroughly covered with powdered soapstone, the surplus being rubbed off. The press is heated to about 220° F., the temperature being regulated usually by a thermometer attached to the press, but this may be dispensed with by exercising due care in the process of vulcanization. A pair of Bunsen burners afford a ready means of securing an even and well regulated temperature.

It is well to make a few small stamps first, to see that everything is working right. The rubber is pressed on the matrix; a piece of sheet tin is placed over the rubber; the mould, with the applied rubber, is placed in the warm press and pressure is gradually applied, thus forcing the rubber into every part of the impression. The time required for vulcanization with a warm press is from three to five minutes; sometimes the time is extended to ten minutes if the press is not sufficiently warm. If the press is overheated, the rubber will be burnt. This is mainly a matter of experience, and can be learned only by actual practice. When the rubber is nearly vulcanized, it has a bluish shade, and if it is pricked with a needle or awl, if the rubber is vulcanized no mark will be left on the removal of the needle; but if it is only semi-vulcanized, the needle will leave a perforation. By occasionally pricking the rubber, the time of exposure to the heat may be roughly determined. A second impression from the mould requires about double the time. When the rubber is vulcanized, it is removed from the matrix by an even pull, and a sheet of stamps thus formed is immediately rubbed with powdered soapstone applied by means of a brush. The different stamps are then cut apart with scissors and mounted on a handle by means of shellac varnish.

A good ink for rubber stamps is made by using 1 oz. of methyl violet (extra 3 B) in 1 qt. of hot glycerine. For the pad, use a piece of felt or cloth saturated with the ink and covered with a piece of silk.

GREEN LEAVES AS PHOTOGRAPHIC PLATES.

IT is not generally known that the production of starch in the tissue of a green leaf may be so regulated and localized by the action of light that such a leaf may be used as a sensitive plate, the image being afterward caused to appear by treatment with iodin, which, as all dabblers in chemistry know, turns starch violet. The Literary Digest translates portions of a lecture on this subject delivered by M. Errera before the Belgian Microscopical Society and printed in Cosmos (Paris). Says M. Errera:

"If we wish to reduce photography to its simplest necessary elements, it is well known that the whole system of lenses may be dispensed with; a blacking box pierced with a pin hole suffices for a camera, on the back of which the image of exterior objects is thrown with exactness. The sole essential elements, then, are: a luminous body (either by rays that it emits or that it reflects) and a sensitive plate.

"M. Clautrian has shown plates for which living beings formed the source of light. Perhaps the inverse experiment will interest you; living matter constituting the sensitive plate, with starch as a product of the photochemical action and iodin as a developer.

"The reaction of iodin on starch is well known, and has long been employed in microscopy."

After describing the special mode of treatment and the result, which is to produce a violet coloration more or less deep, according to the richness of the leaves in starch, the writer goes on to tell of the role played by light in the matter—without which the phenomenon could have no photographic significance. Says he:

"We see that the assimilation of carbonic acid and the formation of starch take place only in the light and in the green parts, while the dissolution of this starch and its migration from the leaves toward the stem keeps on day and night. The quantities of starch that thus appear and disappear are considerable. . . .

"I removed the starch from this bean leaf by leaving the plant in darkness several days. Then leaving the leaf fastened to the stem, I carefully enveloped it in tinfoil in which I had cut the four letters of the word iode [French for iodin], and I exposed the whole to the sun. Two days later I plucked the leaf. Treated in boiling water and alcohol, it became completely colorless and seemed to present no noteworthy peculiarity. But the four letters were reproduced, in the form of starch, and to develop this image imprinted by the sun in the living tissues, it sufficed to plunge the leaf in a solution of iodin. Then, after being dried with filter paper, it will preserve its 'iode' for years.

"The four letters, as you see, are perfectly legible. But this is a very simple kind of image. Gardiner went much further. Instead of a piece of cut tinfoil, he applied to a leaf that had been deprived of its starch a photographic negative. The solar rays favored the formation of starch in the different parts of the leaf in inverse proportion to the opacity of the negative. Gardiner adds that the 'proof' thus obtained can be rendered more durable by treating it with a soluble salt of silver, which will cause iodid of silver to form wherever there is iodid of starch.

"A yet more interesting application—photographic registration by leaves—was pointed out several years ago by Timiriazeff. In order to show that the rays absorbed by the chlorophyl [the green coloring matter of the leaf] are also those that produce the decomposition of the carbonic acid, Timiriazeff projected, by means of a heliostat, an achromatic lens, and a prism, a solar spectrum on a leaf that had been deprived of its starch. After an exposure of three to six hours the leaf was detached and treated with iodin. Starch had formed at places corresponding to the [chlorophyl] absorption bands, and the spectrum had, as it were, written itself in the tissue of the leaf.

"In place of taking the production of starch as an indication of the luminous action, we may also allow mobile organisms to accumulate at the most illuminated portions. With green zoospores Gardiner thus obtained a positive reproduction of photographic negatives; and you all know the classic experiments of Engelmann, in which the light indirectly attracted bacteria by means of the oxygen emitted under its influence by the green cells. I will not dwell on this, for it is outside of our subject, and I have said enough to show you that the leaf merits an honorable place in treatises on photography, by the side of—and in certain respects, above—gelatinobromide of silver."

The following is an average analysis of commercial 80 per cent. ferro-manganese given in the American Manufacturer: Manganese, 80·00 per cent.; carbon, 5·00; silicon, 0·50; iron, 14·25; phosphorus, 0·20; sulphur, 0·05; total, 100·00 per cent. Spiegel, or manganiferous pig iron, is also an alloy of manganese and iron, the difference being only that while in ferro-manganese the manganese contents predominate, the iron contents predominate in spiegel. The latter contains from 12 to 20 per cent. of manganese. In fact, all ferro-manganese that is not rich enough in manganese, can be called spiegeleisen. The other constituents vary in proportion according to the ores used.

SELECTED FORMULÆ.

Hektograph Composition and Inks.—

(1.) Thin French glue ..... 1 pound
Glycerin ..... 2 "
Precipitated chalk ..... 2 ounces
Carbolic acid ..... 1 "

Soak the glue one hour, drain, add the glycerin, and dissolve by heat. When nearly thick, add the chalk and carbolic acid.

(2.) Gelatine ..... 3 ounces
Cut small and soak twelve hours in water ..... 4 "
Then add
Glycerin ..... 40 "

Heat gently until dissolved.

Here is a formula used by the French Ministry of Public Works:

Glue ..... 100 parts
Glycerin ..... 500 "
Kaolin or barium sulphate, finely powdered ..... 25 "
Water ..... 375 "

For ink a concentrated solution of Paris violet is recommended. To remove old copy from the pad, a little muriatic acid is added to the water.

For a tin dish, 7 by 11 in., about the following quantities of the above formula will be required:

Glue ..... 3 ounces
Glycerin ..... 15 "
Kaolin ..... ¾ "
Water ..... 11¼ "

Here are some additional formulas for inks:

(1.) Diamond fuchsine ..... 10 parts
Alcohol ..... 10 "
Acetic acid ..... 2½ "
Gum arabic ..... 10 "
Water ..... 70 "

(2.) Aniline blue, water soluble ..... 10 "
Picric acid ..... 10 "
Alcohol, 90 per cent ..... 30 "

(3.) Rosaniline acetate ..... 2 "
Alcohol ..... 4 "
Water ..... 20 "
Glycerin ..... 1 "

(4.) Villon's formula:
Bordeaux red ..... 3 "
Alcohol ..... 2 "
Water ..... 20 "
Glycerin ..... 1 "

—Pharmaceutical Era.

Gilding and Silvering Iron Wire.—Iron wire to be gilt or silvered is first cleaned in dilute sulphuric acid, then in concentrated nitric acid into which a little soot has been thrown, well rinsed, passed through lime water, and then brought into the copper bath, containing 18 parts of caustic soda, 15 parts of potassium tartrate, and 3·5 of copper sulphate for every 100 parts of water. The wire is there coupled with strips of lead or zinc. The gold solution, which is next applied, consists of 10 parts of gold chloride with 150 of potassium cyanide dissolved in 500 parts of water. In the same quantity of water, and a special vessel, are dissolved 30 parts of caustic potash and 50 of sodium phosphate. This latter solution is prepared hot. When cold, both solutions are mixed, stirred and reheated, when the wire is to be galvanized, which requires a few minutes only. The silver bath consists of 100 parts of silver nitrate, 350 of potassium cyanide, and 1,000 of water. The coated wire should at once be dried and packed with warm sawdust.

Making Carbon Rods and Plates.—Carbon rods and plates of the finest quality can be made economically only by the use of expensive machinery and apparatus, such as pulverizing mills, hydraulic presses, and retorts or ovens; but the amateur, without a great deal of trouble, and with very little expense, can make carbon plates and rods which will answer a good purpose. The materials required are coke, wheat flour, molasses or sirup and water. The tools consist of a few moulds, a trowel or its equivalent for forcing the carbon mixture into flat moulds, tubes to be used as moulds for carbon rods, and ramrods for condensing the material in the tubes and forcing it out, and an iron mortar or some other device for reducing the coke to powder. Clean pieces of coke should be selected for this purpose, and such as contain no volatile matters are preferred. The coke is pulverized and passed through a fine sieve. It is then thoroughly mixed with one-sixth to one-eighth its bulk of wheat flour, both being in a dry state. The mixture is moistened with water (or water with a small percentage of molasses added) sufficiently to render it thoroughly damp throughout, but not wet. It should now be allowed to stand for two or three hours in a closed vessel, to prevent the evaporation of the water. At the end of this time the mixture may be pressed into moulds of any desired form, then removed from the moulds and dried, slowly at first, afterward rapidly, in an ordinary oven at a high temperature. When the plates or rods thus formed are thoroughly dried, they are packed in an iron box, or, if they are small, in a crucible, and completely surrounded by coke dust to exclude air and to prevent the combustion of the plates or rods during the carbonizing process. The box or crucible must be closed by a non-combustible cover and placed in a furnace or range fire in such a way as to cause it to be heated gradually to a red heat. After the box becomes heated to the required degree, it is maintained at that temperature for an hour or so, after which it is removed from the fire and allowed to cool before being opened. The rods or plates are then boiled for half an hour in this sirup or in molasses diluted with a little water. They are again baked in an ordinary oven and afterward carbonized in the manner already described. This latter process of boiling in sirup and recarbonizing is repeated until the required density is secured. As some gases are given off during carbonization, it is necessary to leave the box or crucible unsealed to allow these gases to escape.

ENGINEERING NOTES.

The roller steamer Ernst Bazin has, it is stated, been completely equipped at Rouen, and will shortly commence its trials at sea. The vessel will be commanded by a retired naval captain.

The largest and longest timber slide in the world is said to be at Alprach, in Switzerland. It is eight miles long and composed of over 50,000 hewed trees. Logs placed in it make the slide from Mount Pilatus to Lake Lucerne in from four to six minutes.

The total length of Russian railways, exclusive of those of the Grand Duchy of Finland, on December 31, 1895, was 21,961 English miles. Of these the government lines extended over 13,602 miles, and those still belonging to private companies over 8,359 miles.

The speed of a railway train in miles per hour can, it is claimed, be found by counting the number of rails over which a car wheel passes in 20·3 seconds, because 20·3 seconds bears the same ratio to an hour that thirty feet, the length of a rail, bears to a mile. The fish plates or the thumps may be counted. Thus, supposing that thirty-nine thumps are made by a wheel in 20·3 seconds, the train is then running at the rate of thirty-nine miles an hour.

An experiment was recently made in Vienna in order to test the relative resistance, under pressure, of the hardest steel and the hardest stone. Small cubes of corundum and of the finest steel were subjected to the test. The corundum broke under the weight of six tons, but the steel resisted up to 42 tons. The steel split up with a noise like the report of a gun, breaking into a powder, and sending sparks in every direction, which bored their way into the machine like shot.

Ships with gas engines are apparently gaining favor in France. A new boat of this type has recently been put in service for the Havre-Rouen-Paris line, the speed attained being 7 knots. It is 100 ft. long, with 7 ft. draught, divided into four watertight compartments. The gas is supplied from on shore, and is stored on board in a steel holder, an accumulator composed of steel pipes, under a pressure of 95 atmospheres, about 850 lb. The engine employed is a two cylinder one, of 40 horse power.

Mr. Jos. D. Weeks, in an address before the Manufacturers' Club, of Cincinnati, said: "The best recorded work that has ever been obtained from coal in a steam engine, of which I have any knowledge, was got at Louisville in a triple expansion engine with Pocahontas coal, and everything in the best shape possible. The test showed a horse power to about 1 3-10 pounds of coal—an indicated horse power. The coal consumption per horse power has been reduced to about one-twentieth of what it was originally."

A correspondent of the Engineering and Mining Journal, in North Carolina, writes that a metallurgical car, a stamp mill, chlorination, cyanide and amalgamation plant combined, and fitted up on one car, is in North Carolina, and, like a bee, will flit from place to place gathering good from the mines in different parts of the State. It came from Chicago, and is in charge of Mr. E. W. Bowman, of that city. The object is to test gold mining properties with a view to purchase. The car can be side-tracked at any station on a railroad, and can be kept there as long as necessary.

The new docks at Cuxhaven have been constructed at a cost of 7,000,000 marks, the whole of this amount having been defrayed by the city of Hamburg. The total area of the new docks at present amounts to 60,000 square meters, and the depth is 8 meters, or about 26 ft., below the average low water level. They are therefore capable of accommodating the largest ocean-going vessels. It is proposed to build a large dry dock at Cuxhaven capable of doing the work for which the Hamburg-American liners have now to be sent to England. This dock when finished will cost 3,500,000 marks.

The Hamburg-American steamship Augusta Victoria, after her last round trip this season, will be sent to the yards of Harland & Wolff, at Belfast, to be lengthened. She will be cut in two between the second and third boiler compartments, where the new forward compartments, sixty feet long, will be put. She will carry 100 more cabin passengers, 200 more steerage passengers and about 500 more tons of cargo. Another boiler will be put into her, and it is expected that her speed will be raised above nineteen knots. The Columbia, a sister ship of the Augusta Victoria, will probably be lengthened also.

The special commission appointed by the Dutch government to discuss the scheme of draining the Zuyder Zee recently submitted its report, which states that such an undertaking is quite possible. The work would take thirty-one years for completion, and every year 10,000 hectares of land would be restored to cultivation. A dike thirty miles in length will have to be constructed, extending from the extreme end of North Holland to the western coast of Friesland. The building of this dike, which will be of a width thirty-five meters at the base and six meters high, will take nine years. The total cost of the works is estimated at 26 millions sterling, and the total value of the land thus reclaimed is estimated at 27 millions sterling.

In answer to a question raised in the House of Commons a short time ago by Sir A. Forwood, Mr. Goschen said the number of boilers in use on the thirty hours' trial of the Powerful was forty-eight, the whole number, the total coal consumption 453 17-20 tons, the average indicated horse power 18,459, and the average speed 20·95 knots per hour. There are thirty-nine vessels in the navy, other than torpedo boats, destroyers, and small craft, fitted or being fitted with water tube boilers. The aggregate horse power of these vessels is 421,800. Of these, the Speedy and Sharpshooter have been employed on service with the Channel Squadron, the Speedy since February 20, 1894, and the Sharpshooter from September 15, 1894, to May 6, 1895. Mr. Goschen mentioned that the French man-of-war Alger recently returned from China after a three years' commission with no defects in her Belleville boilers, and that they worked satisfactorily during the whole commission.

ELECTRICAL NOTES.

A telephone line between Frankfort-on-Main (Germany) and Vienna (Austria) will probably be in operation in 1898.—Elektrotechnische Rundschau.

An English journal states that the cost of electricity at Buenos Ayres is 30 cents gold per kilowatt, a small discount being allowed to large users. It adds, however, that it must be borne in mind that all the coal used in generating this electricity has been brought some 7,000 miles, and that the wages paid both for labor and for technical knowledge are very considerably higher than in England.

Milan (Italy) is to have electric street railways. Water power of 10,000 kilowatts is available at about 20 miles from the city, and a current of 11,600 volts will be employed for the transmission of energy. Transformers will reduce the tension to 3,000 volts within the city. Two 6-polar generators of 500 kilowatts and 315 revolutions per minute have already been placed at the power station.—Elektrotechnische Rundschau.

An electric motor carriage, furnished with Tommasi storage batteries, has made 60 kilometers (38 miles) in four hours with one charge. The carriage with three persons weighs 1,200 kilogrammes. Tommasi's storage batteries, weighing 1,000 kilogrammes, can propel a carriage 70 kilometers without recharging; batteries of the old style weigh three to four times as much for the same power. At Liege (Belgium) Tommasi's batteries have been used successfully on street cars. The car with 30 passengers and a 12 horse power motor weighs 6¼ tons, of which 1 ton is for the storage batteries.—L'Industrie Electro-Chimique.

Turin feels bound to award to the late illustrious savant Galileo Ferraris a memorial worthy of his name and the services which he has rendered to science, says the English Electrical Review. A general committee has, therefore, been formed to open an international subscription for erecting at the Royal Industrial Museum of Turin a permanent monument commemorating his scientific and industrial achievements. The general committee at its session of February 24 appointed an executive committee to collect subscriptions. The president of this executive body is the deputy Fada and the secretary Monta, who will be prepared to receive and acknowledge all subscriptions forwarded to him, care of the Cavalier Zappata, municipal treasurer of the city of Turin.

Tower lighting by arcs is still practiced, and is often proposed, for new installations, but does not appear to make much headway, says the Electrical Engineer. It has recently been mooted in connection with the municipal plant for Des Moines, Ia., but it occurred to one of the aldermen to write to the mayor of Davenport, Ia., asking why the tower system was given up in that city some years ago. The mayor's reply is rather emphatic and amusing: "Because," he says, "we did not consider it legitimate expenditure to attempt to light the road to heaven at the expense of the citizens of Davenport." He adds that it is a nice thing to talk about, but a poor substitute for surface lighting as furnished by pole light. That seems to be about the general idea, although there does not appear any good reason why reflectors could not be brought into play to aid in throwing the light downward from inverted arcs. It is possible the plan has been tried and found wanting.

It is declared that the new transatlantic cable to be laid between Brest and New York will be the longest yet submerged. Its length will be 3,250 nautical miles, or about 6,000 kilometers. The core is being made in Bezons, and the different sheathings, or armatures, at Calais, where the cable will be finished. The conductor will have a casing of 13 strands, requiring 975,000 kilogrammes of copper, while the wrapping will take 845,000 kilogrammes of raw gutta percha. The strands of galvanized steel which form the first armature will need 4,687,000 kilogrammes of steel, and it will be necessary to have a further sheathing of iron to protect the parts of the cable submerged near the coast. For this purpose 1,495,000 kilogrammes of iron will be needed. In all, the total weight of the cable for the full length of 6,000 kilometers is estimated at the enormous figure of 10,976,350 kilogrammes. Four ships of the heaviest tonnage will carry it, and it will be paid out in the course of the summer. The submarine cables already laid have a total length of 102,000 leagues. There have been $200,000,000 expended "in their construction, three-fourths of it English money, and 41 ships are kept in connection with the service. Ten years hence we may see all this doubled."

Zeeman, of Amsterdam, has recently discovered a curious influence exercised by the magnetic field upon the period of light emitted by a flame. He introduced into an oxyhydrogen flame, placed between the poles of a Ruhmkorff's electro-magnet, a filament of asbestos soaked in common salt. The light of the flame was examined with a Rowland's grating. Whenever the circuit was closed, both D lines were seen to widen. To eliminate possible sources of error in this experiment, another experiment was made by heating sodium strongly in a tube of biscuit porcelain, closed at both ends, by plane parallel glass plates. The tube was placed horizontally between the poles of the magnet at right angles to the lines of force. The light of an arc lamp was sent through. The absorption spectrum showed both D lines. Excitation of the magnet caused immediate widening of the lines. It thus appears very probable that the period of sodium light is altered in the magnetic field. Zeeman considers that the true explanation of these results is afforded by the theory of electrical phenomena propounded by Prof. Lorentz. According to this theory, there are in all bodies small molecular elements charged with electricity, and all electrical processes are to be referred to the equilibrium or motion of these "ions." Zeeman considers that in the magnetic field the forces directly acting upon the ions suffice for the explanation of the phenomena. Prof. Lorentz, when consulted on this subject, predicted that the light from the edges of the widened lines would be found to be circularly polarized when looked at in the direction of the lines of force; and further, that the magnitude of the effect would lead to the determination of the ratio of the electric charge which the ion carries to its mass. These predictions were verified by experiment, says the English Electrical Review.

MISCELLANEOUS NOTES.

Negus Menelek has received as a present from the Czar of Russia a complete set of wind instruments, a piano, and an organ. Several Russian musicians have been sent with the instruments to teach the Abyssinians to play on them.

In the report of the United States Deep Water Commission, the following paragraph occurs: "This condition of European manufacturing indicates that soon our iron masters can sell their iron and steel in all forms in any part of the world. With deep water access to the ocean, the ores required on the Atlantic could be supplied to the exclusion of foreign ores, the iron and steel business of the country equalized, and our country supplied at a minimum cost, enlarging the field for capital and industry and increasing the prosperity of the whole. At the same time, furnaces and rolling mills on the lakes could produce iron and steel that, water borne, would irresistibly invade the markets of the world."

In consequence of the growing importance of carbide of calcium and the fact that the mere contact of moisture with this material causes a dangerous evolution of the highly inflammable gas known as acetylene, the British Home Secretary has caused inquiries to be made into the subject, with the result than an order in council was made on February 26 under the fourteenth section of the petroleum act, 1871, bringing carbide of calcium within the operation of that act. Accordingly, from the date on which such order comes into force, April 1, 1897, it will be unlawful to keep carbide of calcium, except in virtue of a license to be obtained from the local authority under the petroleum act. Any local authority to whom application may be made for a license to keep carbide of calcium can, if it is desired, obtain, on application to the home office, a memorandum showing the character of the risks to be guarded against and containing suggestions as to the nature of the precautions likely to be most effectual for securing safety.

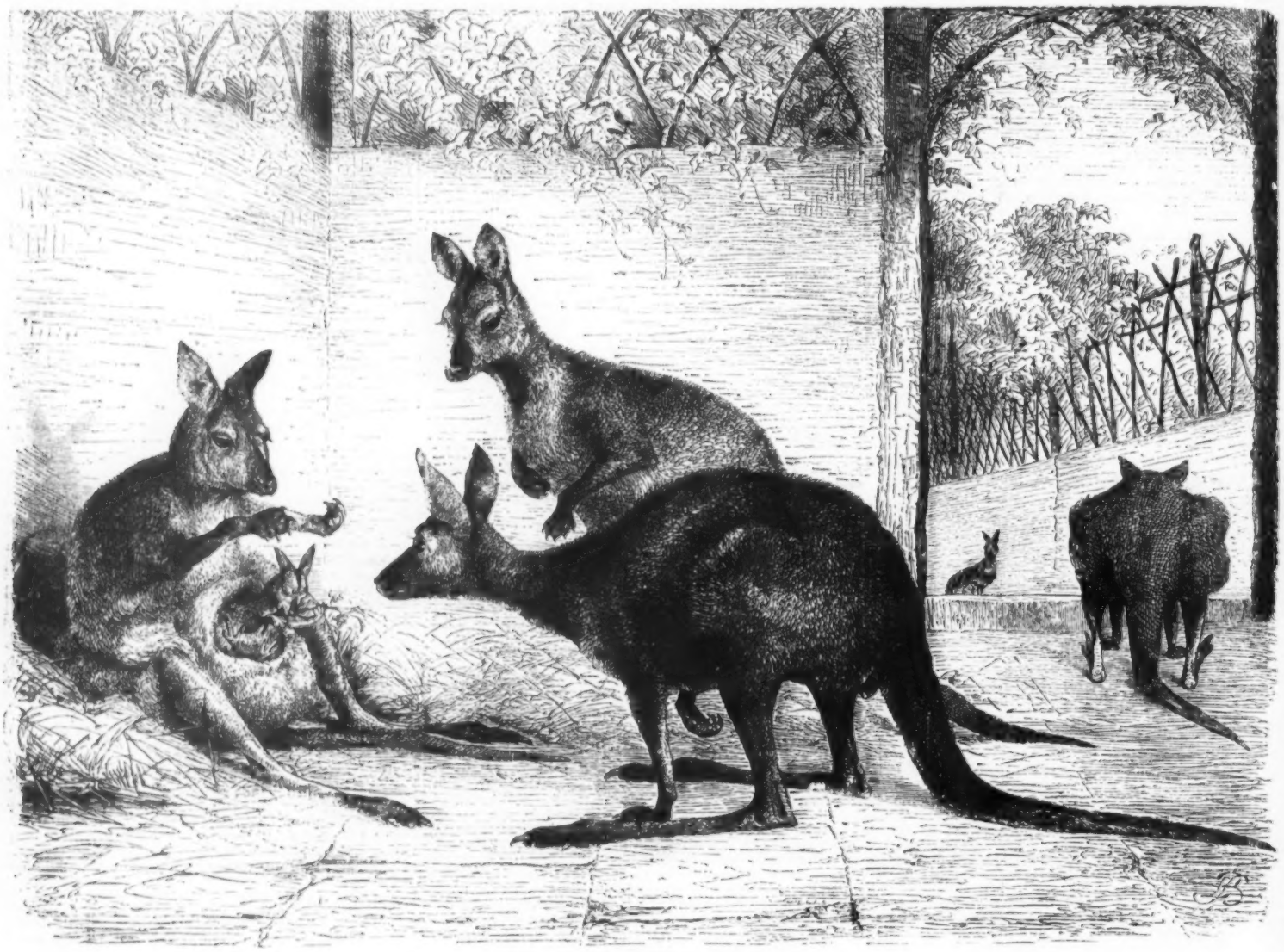
An article by Roland Belfort, on the "Making and Laying of an Atlantic Cable," appeared in the Windsor Magazine for March: "The Faraday was designed by Sir William Siemens, who, dissatisfied with existing cable ships, determined to design one himself. Although a novice in naval architecture, he evolved a ship pronounced by cable experts to be a model. About 5,000 tons register, 360 ft. long and 36 ft. deep, she is one of the two largest cable ships afloat. Three enormous tanks, each capable of holding 1,700 knots of cable. They are so built as to add materially to her structural strength. She has such novel features as double bows and funnels abreast, maneuvers rapidly, and turns in her own length. During an expedition she carries 180 men. The work is divided into three departments, with separate chiefs and staffs, who, however, also work in perfect harmony. The Faraday's decks are crowded with machinery—paying out and picking up gear, huge buoys, grapnels, chains, sounding apparatus, donkey engines, cranes and derricks. Both bows are fitted with large projecting iron sheaves, which keep the cable clear of the ship during operations. These sheaves are inclosed in a railed gangway, which serves as a lookout station for officers and men. Throughout the ship are distributed smithies, carpenter's shop, electric light house, ice house, doctor's surgery, photographic studio, steward's store rooms, butcher's shop, bakehouse and an immense kitchen. A spacious testing room is fitted with electrical apparatus of every description. Comfortable messing and sleeping accommodation is provided for each category of men. The saloons and staterooms occupied by the chiefs and principal officers of the expedition are luxurious, and fitted with all the latest space-saving notions. Bathrooms, buffet and cozy writing rooms complete the installation. Throughout the ship glows the electric light, which also provides powerful searchlights for night work."

Glace fruits are among the most attractive and satisfactory of the varied offerings of first class fruit stores. They come from France in paper boxes, each containing a quarter, a half, or a full pound of inviting preparations, and also in one, two, four and six pound wooden boxes. Some of the larger packages are filled with only one kind of fruit, but these and the smaller ones, with assorted fruits neatly arranged in rows of one kind, are beautiful and make easy buyers of inspecting customers. A two pound box, for example, holds nearly four dozen fruits in seven rows separated by dainty white lace paper. There are small white pears, tiny limes, alternating yellow and green, large apricots, deep and rich in color, green gages, a showy line of rose colored pears, one of delicious looking figs, and by way of novelty and variety English walnuts, thickly incased in a candied covering. Other combinations are made from meaty cherries, with sweet Bigarreau and the sour fruit to choose from, some arranged with straw stems for convenient handling; peaches, fresh looking slices of pineapple, some white and others a wholesome rose color from being dipped in natural fruit sirup; red and white strawberries; melons, the seeds removed and the whole form retained; mirabelles, small yellow plums; young green almonds, prepared with the outer and inner shell, the kernel being hardly formed, and slices of oranges. The colors, which are very distinct, make striking contrasts. These colors are always the natural tints of the fruits themselves, or in some instances of the bright juices of other fruits. Limes, which come green and yellow, are the unripe and the ripened fruits. The prices range from fifty to eighty cents a pound. Turkish fig paste—some white and some pink—is a generally esteemed fruit confection, and apricot paste is more rarely seen. In another class are the candied orange, lemon and Sicily citron, seen in grocers' stocks, and glacé Angelique, or stalks of rhubarb, which are used in confectionery. For several years past a high grade of glacé fruits from California have been sold in Eastern cities, including figs, plums, cherries and other sorts. Crystallized ginger is, perhaps, the best known of all these confections, and Brazil nuts and other imported and native nuts are largely used in candied coverings, while fruit bars are popular. Among the most costly delicacies are candied rose petals at $1.50 and violets at $2.50 a pound. Many of the fruits also come crystallized, or with an additional coating of granules of sugar.—Garden and Forest.

KANGAROOS AND THEIR YOUNG.

This strange looking animal, so little known outside of museums and zoological gardens, has not been found out of Australia, but there it was so abundant a few years ago as to be almost a pest. When it was found, however, from 1873 to 1880, that its skin could be made into a fine, soft leather, suitable for ladies' shoes and an infinite variety of small articles, the demand for the stock became so great that the kangaroos began to be killed off very rapidly. They have not, however, disappeared, as was the case with our American buffalo, for they are very prolific, and their rapid breeding accounts for there still being large numbers of them in Australia, from which we annually receive considerable supplies of kangaroo skins, but by no means as many as came to this market a few years ago.

As may be seen from our illustration, the shoulders and forelimbs are feebly developed, giving the kangaroo a very awkward appearance when moving about on four limbs, as in feeding, but they move very rapidly by leaping in immense bounds. When not moving they often assume a perfectly upright position, the tail aiding the two hind legs to form a sort of tripod, this position enabling them to see, hear and smell to best advantage when the approach of enemies is suspected. The stomach is of large size, and formed by a fold of the skin of the abdomen is a pouch covering the mammary glands with their four nipples. In this pouch the young are placed as soon as they are born, remaining in it during their growth and development, and resorting to it temporarily, for shelter, concealment or transport, for some time after they are able to run and jump about the ground and feed on the herbage which forms the nourishment of the parent. The kangaroo is naturally timid and inoffensive, but the large ones are sometimes dangerous customers when attacked.—We are indebted for our illustration to the Zoological Garden, published by J. J. Weber, Leipzig, Germany.



A GROUP OF KANGAROOS.

PEAT BOGS AND MIGRATORY MOSSES.

By Dr. G. Archie Stockwell, F.Z.S.

The recent bursting of a bog* on the 28th of December last,† at Knocknageeha, Rathmore, County Kerry, Ireland—twenty miles east of Killarney, on the confines of County Cork—as the result, possibly, of almost incessant rains that prevailed for several weeks, has stimulated new interest regarding the source of peat fuel, and the origin and occasional movements of bogs; for the accident at Rathmore is far from being the first of its kind, and such are by no means confined to the land of the shamrock and harp.

Considering the nature of bog formations, which are widely spread throughout the United Kingdom, the miracle is not that one should occasionally slip its moorings and go astray, but that accidents of this character are of so comparatively infrequent occurrence. To fully appreciate this, the fact must be recalled that there are, or have been up to within recent times, more than 1,000,000 acres of such unstable character within the limits of South Britain, double the amount in the Northern Kingdom, and more than three million acres, or one-seventh of its area, in the Emerald Isle.* The great bog of Allen, east of the Shannon, extends fifty miles in length by an average of two to three in breadth, but is divided by occasional ridges into several morasses; it consists of successive layers of peat, nowhere less than twelve, and often nearly fifty feet in depth, that has been observed, in some of the older cuttings or "turbaries," to renew itself at the rate of an inch and a half or two inches per year. This morass, however, pales beside the great peat marsh of Montoire in France, situate at the mouth of the Loire, which boasts a circumference of fifty leagues.

But bogs are by no means confined to the United Kingdom, being widely distributed throughout the temperate zones and subpolar regions; thus considerable portions of the Netherlands, the two Scandinavias, Finland, North Germany, Russia, Siberia, Alaska and British America are of this character, and the same holds good of Patagonia and the great insular regions to the southward, as well as of Newfoundland, Iceland, the Shetlands, etc. Denmark, Livonia, Pomerania and Courland are as celebrated as the British Isles for their morasses, though many of the former are not true peat bogs in the sense of affording fuel, but doubtless might be transformed into such, in time, if relieved of forest growth. Neither are such morasses as the Dismal Swamp of Virginia and the Everglades of Florida to be considered in this category, in spite of the fact that both contain considerable amounts of peat matters. The cedar swamps of southern New Jersey come nearer being peat bogs; but the marshes in the vicinity of the Great Lakes, and notably the great area lying between Chatham and Lake St. Clair, in Ontario, though often promised as a source of combustible turf, are morasses only by grace of the large body of water adjacent, at times are almost entirely dry, and the deposit of carbonaceous vegetable matter is too slight in depth to ever prove a source of fuel, even were it not a fact that most of these are being rapidly filled up, or brought into condition for cultivation, and that all such swamp formations will have disappeared ere another decade has elapsed.

Bogs are twofold in topography and origin. Many, especially in Scotland and Ireland, are situate on high grounds, often the most commanding point of the region, and draw their moisture from springs fed from the bowels of the earth; others are low, lying perhaps at the most dependent point of a vale formation, and kept wet through the natural drainage of the surrounding area. Some have been forests, as is evinced by the buried timber, etc., and the still upright stumps and roots that are continually being discovered.

The very destruction of tree growth, interfering with surface drainage, aided by the deposits of sphagnum and extraneous matters, brought about the bog formation, though at one time they may have been, as was probably the case in most instances, wet forests. Thus the marshes of North Gaul have been identified as the sites of the erstwhile forests of Hercinia, Senaar and Ardennes, that, according to Dion Cassius, were deprived of their timber by the Roman conquerors—a common procedure in the early history of Europe, for Galen tells us the imperial cohorts were kept continually engaged in this work and in "draining the marshes and paving the bogs" in the regions occupied and garrisoned, since such areas afforded convenient harbor to guerrilla bands that could neither be conquered nor dispersed until their fastnesses had been destroyed. Suetonius Paulus pursued similar tactics in Anglesea; and Cæsar details most fully like procedures in Britain. Indeed, many of the existing bogs or fens* in England and Scotland owe their existence to the author of The Commentaries or his immediate successors. Cæsar personally informs us that the tribes of Britain, when pursued by his conquering legions, took refuge in "miry woods and low watery forests that no one could traverse but themselves;" that Cassibian and his followers after being defeated crossed the Thames and "fled to the low morasses and woods," issuing from thence, suddenly and in small parties, to fall upon isolated bodies of their foes, and so continually harassed the Roman armies that it was found necessary to systematically destroy all wooded fastnesses. The Silures are accredited with thus, for a long time, thwarting and practically rendering null the operations of Ostorius and Agricola; and Venutius, King of Brigantes, for a long time resisted the conquerors by fortifying himself "in a bog in the middle of his kingdom." Finally, one cannot study the semifossilized trees which are so generally found in bog lands without being reminded that Britain was at one time clothed with gigantic forests, such as to-day seem impossible to have ever existed, all of which lends color to the statements of various Latin authors, that in South Britain alone no less than fifty thousand troops, in the brief period of two years, succumbed to diseases contracted while clearing morasses of their wooded growth.

So also Edward I, not being able to conquer the Welsh because of their guerrilla and partisan methods of warfare, and constant hiding in the fastnesses of boggy forests, undertook the extirpation of the latter after the manner of the Romans, and the roots and

* Bog is a Celtic Irish word meaning "soft."

† See Scientific American Supplement, February 6, 1897, page 17693, No. 1101.

* The central portion of Ireland is the great region of bogs. Between the two bays of Sligo and Galway is a considerable area that juts out into the Atlantic and is the beginning of a strip of practically equal breadth, extending in an easterly direction clear to the Irish Sea, including nearly one-quarter the area of the island, and it likewise embraces six-sevenths of the bogs, not taking into account those of less extent than eight hundred acres each.

* What is known as a "bog" in Ireland becomes a "moss" in North Britain, and in South Britain is commonly denominated a "fen," though the latter is in many instances inappropriate in application, inasmuch as it is supposed to identify a series of bogs separated by open areas of water or ponds.

trunks of arboraceous growth that are to-day found under ground in Pembrokeshire are admitted to be the mortuary evidence of the success of this undertaking. Henry II. too, when conquering Ireland, was forced to like measures, and ordered all the woods growing in the marshy parts of the island to be felled "in order that they should never again give shelter to rebel hordes." The bogs of the Isle of Man manifestly have some such origin; and the overthrow of a forest by a storm about the middle of the last century gave rise to a "moss" near Loch Broom, in Rosshire, Scotland, where in less than half a century thereafter the inhabitants dug peat.

But none of the bogs appear to antedate the present epoch, judging from geological features; yet some are of greater age than others, the oldest in Ireland being those in which are found remains of the gigantic Hibernian elk, the wild ox and buffalo, and other creatures that have been so long extinct they find no place in the history or traditions of existing races; these, as well as others on the Continent, likewise have yielded the canoes, skeletons and wearing apparel of hair clothed aborigines.

Most of the English bogs—notably that of Hatfield Chace, in Yorkshire, with an area of some 180,000 acres, cleared up in the latter part of the seventeenth century—especially those in which the remains of a former tree growth are found, have yielded the coins, chains, weapons and other implements of the Roman invaders; even axes and wedges have been found sticking in the semifossilized and felled timber. In a bog near Kincardine, Scotland, in May, 1768, at considerable depth was found a large round vessel of brass, of curious workmanship, sixteen inches high and twenty-five in diameter—rightfully or wrongfully, as the case may be, termed a Roman camp kettle—that by the grace of John Ramsay, Esq., of Ochtertyre, is now numbered among the possessions of the Antiquarian Society of Edinburgh. Medals of Gordian and Vespasian have been dug up from bogs at depths of from twenty-five to thirty feet.

To appreciate the circumstances that lead to moss migrations or bog slips, it is necessary to study carefully their formation and constituents. If the trunks of trees found therein are cut and hewed, the interference of man is most evident; whereas if the felled timber presents no marks of the ax, but is broken or overturned at the roots, natural causes must be accepted. If a depression or valley fed by springs becomes choked at its outlet from any cause, water accumulates, which in time destroys existing vegetation, and the latter is quickly replaced with another of aquatic character; or a forest is laid prostrate, and, with the aid of extraneous matters deposited, soon interferes with natural drainage, when the accumulated water becomes stagnant, and the result is to all intents and purposes parallel. Accruing grass seeds and marsh plants are soon in thriving condition, and in turn are followed by water mosses, commonly those of the genus Sphagnum, which speedily assume an exuberant growth about the margins, and then gradually extend over the pond surface. All sphagnums have the peculiar property of parting with vitality at their roots in proportion as new growth and life accumulate above; the dead and dying portions slowly undergo change, ultimately becoming brownish black in hue, loose in texture, friable and held together only by the penetrating and interlaced root fibers. Layer succeeds layer, the lower by weight and impact becoming more and more homogeneous, until ultimately they assume a pitch or coallike character, but are far more combustible than ordinary coal carbons, owing to the enormous proportion of contained oxygen—twenty-five to thirty per cent. The rate of accumulation, of course, varies with the amount of vegetation, moisture, addition of extraneous matters, etc., but a more or less cool and humid climate seems indispensable. Twelve inches in depth for each decade may, in one case, measure the rate of progress, while in another such an accumulation may demand a quarter of a century. In one notable instance three inches per year was observed. In the main, the development is about three-fourths of an inch per annum.

Some of the "turbaries" in Scotland have been dug for fuel to thirty feet or more, and many in Ireland to twice this depth. Many beds have yielded fuel for centuries; others, exhausted a hundred years ago, are now again a source of turf fuel. It must be remembered, however, that peat, as taken from the bog, is nearly one-half water, and that it can likewise, by compression, be reduced to one-fifth its original thickness; in fact, it must be so compressed ere it is available for such quick and strong fires as are demanded for the ready production of steam.

The moss-covered pond gradually forms a loose turf, which of course embraces the roots and leaves of other plants, and branches and twigs of larger growth; thus is provided excellent lodgment for wind-borne dust and frost-felled foliage. Above the sphagnum finally assumes such proportions as to change the entire area from a soft morass to a peat bed, presenting a dry crust of fair appearance, that, however, shakes and vibrates under the least impact, since below it is semifluid, of spongelike character and consistency, and may wholly float upon the surface of water. When the marsh plants die out they are succeeded by heath, broom and other forms of growth that continue to carry on the process of accumulation, at a less rapid, perhaps, but still perceptible rate. And now, save in spots, the surface will tolerate the foot of man, and perhaps affords means of traverse, and some slight pasturage to his domestic creatures. Some of the most treacherous may be crossed by an expert in dry weather, but the adventurous traveler must pick his way carefully by the aid of rush tussocks, for it is at the roots of these that the soil is most firm; but if his foot slip or he ventures upon any other part, there is always the risk of being speedily overwhelmed in a quagmire that only with difficulty can be made to give up its unfortunate victim.

Not infrequently the peat accumulation luxuriates till, by its simultaneous processes of growth and decay, it reaches a height considerably beyond that of the surrounding land, and in proportion to its excrescence-like development, especially when overloaded by heavy rainfall, may become dangerous to the regions about; the accumulation of water, favored, perhaps, by geological features, is usually the primary cause that forces mosses to leave their moorings, carrying terror, destruction and even death in train. A bog, even if possessed of a firm crust, deep down always retains more or less of the characteristics of sponge, whereby it is ever capable of absorbing enormous quantities of moisture; and this constitutes the chief source of danger, inasmuch as when the great body of the deposit is overcharged with aqueous matters, it is lifted from its bed, and the added weight facilitates migratory movement.

(To be continued.)

THE GROTTO OF MOUTHE.

THE grotto of Mouthe is located in the hamlet of Mouthe (whence the name that we give it), commune of Tayac, canton of Saint Cyprien, district of Sarlat, department of Dordogne, France. It is situated at an altitude of 630 feet, say 400 feet above the level of the railway, which passes at about two miles from the place, on the side of the Eyzies station. It is at the summit of a wooded hill, whence the view extends to quite a great distance. Formed naturally in the upper cretaceous, it opens by a semicircular space 35 feet in width and 10 in height, at the partly wooded edge of a sort of amphitheater of slight depth, the widest diameter of which does not exceed 590 feet. It is preceded by a small plateau descending by an easy slope toward the back of the amphitheater, the level of which, on the day that we visited it for the first time, was nearly the same as that of the grotto at the entrance, and, consequently, at about twenty feet above the said extremity. Finally, the hamlet of Mouthe is scarcely 900 feet above the threshold of the grotto. The orientation of the latter is southeast, and the rock in which it is formed consists of granular limestone of slight cohesiveness and very impure, it being mixed with clay and containing grains of quartz.

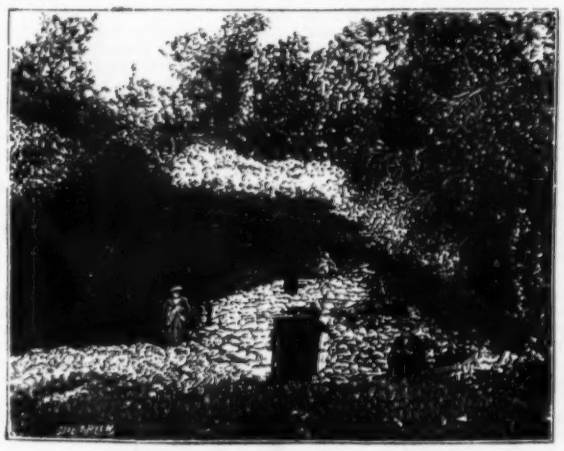


FIG. 1.—ENTRANCE TO THE GROTTO OF MOUTHE IN 1895.

From the time that we first undertook a study of this grotto we have explored it on four different occasions, in making a preliminary cutting in order to ascertain its length and, from the surroundings, to find out the epoch, or the successive epochs, at which it has been inhabited, to ascertain the authenticity of the carvings that we were told had been made on its walls, to discover others if there were any, to take squeezes of some of them at least, if possible, and to determine the epoch, ancient or modern, from which these carvings seemed to date. The results of these four visits were as follows: Upon our arrival at Mouthe on June 24, 1895, starting from the point where the mouth, like that of an oven, had been uncovered, the grotto was filled up almost to the ceiling. The semicircular mouth, in fact, measured but 14 inches at its greatest height and 25 inches in width. Fig. 1 shows the entrance to the grotto in 1895, closed by a wall of dry stones. The floor was, at a height that we estimated at about 12 inches, that of a neolithic hearth. A section of the rock, made from top to bottom at the entrance, allowed us to ascertain that the grotto had been inhabited by man (prehistoric man alone, at least in the virgin part of all the excavations) at two distinct epochs—in neolithic time and in the quaternary epoch, geologically speaking. In fact, the superficial stratum is formed exclusively of deposits of ashes and charcoal that, along with a certain number of stone implements, contained bones of animals belonging to the present geological epoch, numerous fragments of coarse primitive pottery and some human bones, a few of which seemed to have been derived from one and the same subject. This stratum rests immediately upon a more or less thick stalagmite which separates it very distinctly from much more ancient deposits, as is proved by the remains of the fauna that we collected. In this same stratum we found also numerous stone implements (some of which were very thick chisels), some weapons and some bone instruments, among which we may mention a very fine and well made needle, almost entire and remarkable for its length (seven inches). We likewise discovered in these same deposits some bones engraved with lines, as well as some perforated teeth designed to be worn as ornaments or amulets. But we found here no pottery, no polished stones and no human remains.

FIG. 2.—ANIMAL CARVED UPON THE WALLS OF GROTTO OF MOUTHE.

At a short distance from the mouth of the grotto the neolithic deposit ceases completely, leaving the stalagmite bare. On the contrary, the quaternary deposits remain, but are, as a general thing, not so rich as at the entrance. Their color is not so black, but of a dark red shade, borrowed from the clay with which they are more or less mixed. Further along there are no longer any true hearths, but it is the more or less pure stratum of clay, sometimes sandy, that here and there contains carved stones, along with the remains of the same quaternary fauna. Finally, at certain points, especially at 200 feet from the entrance, we find true accumulations of the remains of bears, hyena teeth and numerous coprolites of the same animals. From the objects generally that it has thus far furnished us, the grotto has not only been inhabited by prehistoric man at two very distinct epochs, but has also, at given times, formed the den of bears, while the cave hyena has likewise made it its abode, or at least has made incursions into it on several occasions and of longer or shorter duration.

It was on April 11, 1895, that the first figures carved upon the walls of the grotto were perceived by our correspondent Mr. G. Berthou-Meysou, who, at our request, entered the grotto as far as he was able, despite the narrowness of the passage, which was such that, before the cutting was made, it was possible to advance but slowly and in creeping. Now, these figures are not only not apocryphal, but, after minute study, appear to leave no doubt as to their antiquity. Some of the carved lines are prolonged under the stalagmite that covers them.

The cutting that we began in the month of June, 1895, and have since continued at the time of each of our visits, has now reached a distance of 450 feet from the entrance. It is at present open to a width and height almost sufficient to allow a person to walk nearly upright without being obliged to stoop, except in the terminal part. But, upon reaching this point, we have found that it is possible to go beyond for an additional length of about two hundred and thirty feet

by crawling upon the belly, so nearly does the stalagmite approach the ceiling.

At several points of this new passage the hammer has brought to light bones and teeth embedded in the stalagmite. But at this distance of about 650 feet the passage becomes so narrow that it is impossible to traverse it without breaking away the stalactites or stalagmite that obstruct it.

As for the figures that we have been able to study, and which constitute the most important discovery that has been made in the grotto, they are of two kinds—simple line carvings made in the walls and ceiling of the grotto and others of the same kind, but some of the lines of which have been filled in with ocher, so that they have assumed a dark brownish red color. Finally, a third kind of figures consists of a sort of striation of the rock (the lines of which have been colored in the same manner) rather than of a true carving. The first and second represent animals only. They are carved in the rock quite superficially, for the most part, so that it is often very difficult to obtain a squeeze of them. I may mention a bison and another animal the hind quarters of which seem to be those of a bovid, while the head, which is unfortunately somewhat defaced, appears to be that of a horse with short and bristling mane. Equid or bovid, the animal (of which Fig. 2 shows us the outlines carved upon the wall of the grotto at 310 feet from the entrance). from the extremity of the nose, which is somewhat tapering, to the point of the tail, which is directed somewhat obliquely downward, measures no less than six feet in length. The photograph was obtained after many trials by Mr. C. Durand, a learned geologist of Perigueux, thanks to an illumination of one hundred and forty candles and an exposure of four hours and a half.

The fauna, of which we collected various debris, comprises insectivora, carnivora (especially of the genera Ursus, Canis and Hyæna), rodents (Castor), pachyderms (Equus and Sus), ruminants (Cervus, Bos and Capra, and principally the reindeer), reptiles of the genus Rana, birds of several species, and a few invertebrates, some terrestrial, such as Helix, and others marine, such as Patella and Nassa. We must mention particularly a piece very rarely found, we believe, in the quaternary caverns of France, and that is a fragment of a tooth that seems to have belonged to a hippopotamus. We must also mention a piece of a rhinoceros tooth.

Such are, briefly summed up, the principal results of the excavations that we began in the month of June, 1895, and have carried on since up to the month of September, 1896.—E. Riviere, in La Nature.

[Continued from Supplement, No. 1109, page 17732.]

TECHNICAL EDUCATION IN EUROPE.*

By C. P. Brooks, Director of the Lowell Textile School, Lowell, Mass.

The English technical school system is one which is very interesting, not so much on account of the work that has already been accomplished, but the great possibilities that are in store.

Of the five important classes of technical institutions that I have previously considered in connection with Continental European technical education, only three of these classes are well represented in England. There are what may be called the technical universities, which are the higher schools for instruction in physics, in chemistry, in engineering and architecture, many of which are old established and very admirable institutions for their special purposes, and schools which have been endowed with funds to perfect their equipment in a very special manner are to be found in special centers. These schools are not purely technical schools. In the training of a professional man they are admirable, but in the training of the craftsman or the superintendent or overseer of craftsmen or of machinery they are only useful in teaching the best manner of approaching a study, a problem, or in training the mind to approach everyday problems in a scientific and systematic manner.

The fourth of my class of schools, the manual training schools and the industrial schools, are numerous in England, well organized, and give instruction to a large number of students; in fact, in the year 1895 there were 67,470 in the day manual instruction school, comparing very noticeably with the numbers of only four years previous, when only 2,568 students were under manual instruction.

In the other two classes, viz., the secondary technical schools and the fifth class, that is, the higher grade school for specific trades, very few examples are to be found in Great Britain; but of the third class, viz., combination schools of science, art and technology, which are practically combinations of trade schools and of science and art schools, there are an unusually large number; in fact, this combination of science, art and technical school is the chief feature of English education.

In order to thoroughly understand the position of technical instruction in England, we must glance somewhat over the past history of science, art and technical instruction in that country.

There is probably no country in the world which offers so many facilities for popular instruction in the sciences, pure and applied, as in physics, in chemistry, mathematics, astronomy, and also instruction in art in all its branches by means of conveniently situated and almost free evening schools.

These schools are established by the local authorities and are supported and controlled by the government through the council on education, almost entirely by means of payments on the results of the annual examination. The examinations in art, in connection with the science and art department, originated in 1853, were amended and developed in 1857, while the science examinations were announced in 1859, and the first general examinations held in 1861. In the year 1857, 12,502 students were instructed in local schools of art, entirely independent from the children who received instruction in drawing in ordinary elementary schools. In the year 1895 the number receiving instruction in schools of art and science was 136,768, exclusive of over 2,300,000 children receiving the same instruction in the ordinary elementary school, making a total of 2,443,153 persons receiving art instruction in 1895, as against 909,206 in the year 1882 and 56,117 in the year 1857. In science in the year 1861 there were 38 classes with 1,330 pupils. In the year 1882 there were 1,403 science schools with 4,881 classes and 68,581 students. In the year 1895 there were 2,673 schools with 9,545 classes and 190,386 students.

These figures show that for the last 30, almost 40 years, there has been built up gradually, but steadily, a system of science and art instruction in England, which can be and has been taken advantage of by the working man and working woman (for payments on results are made only when the student's income or parent's income is under $2,500 per annum), and which has grown to be so great an organization that in the year 1895, 337,000 individuals attended the classes of their own free will, mostly in the evening and at nominal cost to themselves, as their instructors are paid by the government grants on the results of the examinations, in addition to 2,300,000 children from elementary schools.

The system is not a perfect one, though admirable in very many respects. The system of payment on results tends too much to cramming for examinations and to inducements being offered for a number of subjects to be studied superficially, instead of one or two thoroughly.

The whole of the technical instruction in England has been practically tagged on to this system of science and art school.

To the institution known as the City and Guilds of London Institute, and especially to Sir (then Mr.) Philip Magnus, its secretary, now the superintendent of technological examinations, must be given a very large share of the credit for the introduction of a system of technical instruction in England. About 1879 the Society of Arts, which had done something for two years previous toward establishing a voluntary technological examination without making any payment on results, turned over the conduct of these examinations to the above-named institute, which was established by the wealthy London guilds or city livery companies for the purpose of providing and encouraging education adapted to the requirements of all classes of persons engaged or preparing to engage in manufacturing and other industries.

This association voluntarily made contributions in sums of various amounts toward the building of suitable local schools, and grants in aid of the establishment of technical schools, but their principal work was in organizing a system of examinations conducted in local centers, but in accordance with fixed standards and by recognized authorities; in making payments on the results of these examinations to the teachers of the classes, and in preparing syllabuses for the guidance of teachers and of organizers of technical institutions. This system was not only applied to Great Britain, but examinations were and are concurrently held in India, Australia and other British colonies.

For over 10 years, from 1879 to 1890, this institution built up the technical instruction system of England and deserves all the credit that it is possible to give for the excellent work done voluntarily by the London guilds.

During the interval above named, owing to a very strong pressure brought to bear on the government by advanced educationalists who had become aware of the immense strides made on the Continent of Europe, and especially in Germany, in the advancement of technical education, and by wideawake merchants who could foresee the disastrous results that were likely to accrue to British trade if something were not done to foster technical instruction in England, a royal commission was appointed in the year 1881 and published various reports during the succeeding years. The effect of these reports was to open the eyes of the British manufacturers to some extent to the great progress that was being made by their Continental competitors in the better trade education of the workman, the overseer, the superintendent and the employer himself, and the Queen's Jubilee in 1887 was celebrated in England in many cases by the addition of technical schools to the existing science and art schools. A couple of years later the technical instruction act was passed, which was the first instance of the government officially recognizing technical instruction. A year later a windfall occurred, which placed technical education in England on a permanent basis.

In the session of 1890, Parliament levied additional duty on the manufacture of beer to the extent of 6 pence per barrel, which was estimated to yield an income of $3,750,000 per annum, and they found the money was not applicable for the purpose for which it was originally intended and a fresh use had to be found for it. Friends of technical education were wide awake to the opportunity, and the took the matter up, and in a very few days the whole sum was appropriated for the advancement of technical education.

The amount was appropriated to each county or county borough in the country, which in turn made sub-appropriations to individual towns, villages and institutes, and thus indirectly the brewers of the United Kingdom support the technical schools, which is a very judicious arrangement. The drink evil is at the root of such misery as exists in England and it is fitting that the advancement of the people's interest by means of technical instruction should be an assessment on the brewing trade.

The immediate results of the distribution of this sum of money and the knowledge that a similar sum would be distributed annually resulted in the establishment of technical schools or technical classes wherever needed. Scarcely a town of any importance but what has an organized class or technical school for systematic education in the local industry, and even large villages have schools. While the results of the bill appropriating this annual sum have on the whole been satisfactory, still the forced development of these technical schools is far from having been the healthiest growth. The forced establishment of some kinds of technical instruction has resulted in much ill-advised expenditure, and to educational development in wrong directions, owing to the lack of knowledge as to what technical education really meant, and in, perhaps, the greatest evil of all, the establishment of classes without an adequate supply of trained teachers. On the other hand, the money came very opportunely to the assistance of many educational institutions, especially in the larger cities, where persistent attempts had previously been made to establish technical schools under the auspices of the City and Guilds of London Institute, supported or assisted by local contributions.

The result of this legislation has been on the whole beneficial. There are great possibilities in store for the English technical school. The errors in organization and in non-centralization will be corrected in the natural course of events, the supply of teachers will be created by the demand for them, and the certainty of a fixed and permanent income will materially help the movement.

These technical schools have been in most cases added on to the existing science and art schools, in many cases under the same roof, or a new building has been erected for the accommodation of all three branches. Every facility is now offered at a nominal cost for giving at least a superficial knowledge of science and art and technical education, and in many places for very thorough instruction in science and art and technology in all of its branches so far as it affects the local industry or industries.

In the technology branch the subjects taught are very varied, including brewing, slate quarrying, leather tanning, hat manufacture, photography, dress making, lace manufacture, railroad car building, gas manufacture, bookbinding, every branch of textile manufactures, in fact in all about sixty-six distinct trades. In many cases, three or four of these subjects are taught in the same school, and, owing to science and art classes being held in the same building, students have an opportunity of studying those sciences and branches of art that apply to their own trade.

Instruction is almost entirely evening, only a small percentage of the schools having day departments. The fees for evening classes in most cases are nominal and for the day classes, although higher, still insufficient to cover the cost of instruction. Since the appropriation made for technical education by the government the grants from the City and Guilds of London Institute have been discontinued, but this institute is still recognized as the controlling power over technical education in Great Britain. Its position is entirely unofficial, but it is tacitly recognized by all of the technical institutions of the country as the leading examining body. Its appointment of an examiner is accepted by all the institutions, and students from all the schools accept the decision of the institute in the matter of certificates or diplomas as final and decisive.

For five years I was the examiner of the City and Guilds of London Institute in the department of cotton textiles, and it is with great satisfaction that I and all other friends of the institute view the excellent position it still maintains in the British technical educational world, although it does not now assist financially any schools outside of London.

The general results of this institution's work show that in 1878 there were no classes held, but 202 self-educated students presented themselves for examination; in 1881 classes were held at 78 centers, with 2,500 students in attendance; and in 1896, 1,128 classes were held in 380 different towns and villages, and 26,609 students attended them. These figures apply exclusively to technical classes, and not to science and art classes.

Among the advantages of the English technical instruction system, first may be placed the easy facilities that are given the artisan for attendance at the school, the great varieties of subjects taught, so that one or more are applicable every trade, and the single standard of grading controlled by the City and Guilds of London Institute.

Among the drawbacks to efficiency in the English system may be mentioned two important ones: one is the great lack of trained teachers through a rapid establishment of so many schools and previous absence of facilities for satisfactory training; and, secondly, the decentralization of the schools. Instead of having so many schools or institutions, in many cases only partially equipped, it would be much better to have well organized, efficiently equipped central schools in each section of the country for each important industry, which would in effect be trade universities, which could be used for the training of teachers and for the instruction of superintendents, managers and overseers in such a manner as is impossible in three-fourths of the technical schools that at present exist in England. From this central institution, lecturers and apparatus could be supplied to local institutions on the lines of the university extension scheme.

There are also a very few schools in England which make a specialty of instruction in one trade only and in the branches of that trade and of the sciences and art allied to it. It is too common for attempts to be made to teach too many trades and not specialize any one, thus in England few schools can be found with exactly the same organization and established for the same object as the weaving school at Crefeld, in Germany, or the school of horology, in Geneva, and if I may be allowed to add, the Lowell Textile School, at Lowell, Mass., of which I now show on the screen some interior views. The latter school will, when all the machinery arranged for has been installed, be the most complete and best equipped purely textile school in existence.

As an instance of the rapid progress that is being made in the direction of technical schools, I now throw on the screen a view of the school now being erected in Manchester, Eng. The organization of this institution was completed in 1882 and the old Mechanics Institution utilized for the purposes of the school. The school was commenced in that year, but the number of students has repeatedly necessitated the extension and acquisition of new buildings, and now the Technical Instruction Committee of the city of Manchester are engaged in erecting a new school which will cost almost $1,000,000.

In the various buildings in which instruction is being given, there are 160 lecturers and assistants engaged in the operation of the school, which includes a manual training school, day and evening science school, day and evening art school, day and evening school of languages, and day and evening technical school in which instruction is given in mechanical engineering, sanitary engineering, plumbing, brewing, spinning, weaving, silk manufacture, dressmaking, millinery, and many other subjects. The new school has about 50,000 square feet of floor space on each of five floors.

I also throw on the screen a plan showing the general arrangement of the new building, of which the notice-

* A paper read before the Society of Arts of the Massachusetts Institute of Technology, Boston, Mass., March 25, 1897.

able features are proximity of the lecture halls to the practical work rooms and to the lecturer's private rooms, the incline to the bicycle room, and the fact that the whole of the third floor will be devoted to chemistry and chemical industries.

A representative school is the Birmingham Technical School, which is largely, if not exclusively, an evening school. Birmingham is one of the three centers sending the largest number of candidates for examination outside of London. The technical department includes almost all branches of metal working trades and there are 34 lecturers and assistants.

There are many other technical schools of high reputation in Great Britain, including the Bolton, Blackburn, Dundee, West of Scotland, and Harris Institute technical schools.

The Bradford Technical School is one of the oldest established technical schools in England.

The Yorkshire College, in Leeds, of which a view is shown on the screen, and which is in the first rank of technical institutions in the United Kingdom, is one of the colleges of the Victoria University. Although it is not a technical school in the ordinary sense of the word, yet it has departments in technology; for example, the textile department, dyeing department, and leather industries department.

The Halifax Technical School is one of the latest additions to British technical institutions and is shown on the screen.

Prior to the appropriation by the British government in aid of technical and industrial education, several enterprising private firms, seeing the advantage that would accrue to them by the establishment of a technical school for the benefit of their own apprentices, and anxious to forward the movement in every possible manner, established technical schools in their own works. Among these may be mentioned Messrs. Mather & Platt, of Salford, at the head of which firm is Mr. William Mather, who visited your institute in the course of a tour of inquiry on technical instruction in the United States; the London and Northwestern Railway Company, Sir William Armstrong & Company, and also Howard & Bullough (Limited), of Accrington, England. I show on the screen a view of the works of the latter company, showing the building set apart for their technical school. In this school the whole of the apprentices of the firm receive instruction in such technical trades as appertain to the work of the company and in all sciences allied to the same.

The fact of private firms going to the expense of these schools is a proof positive of the advantages that they have received or expect to receive from them.

I am not here this evening for the purpose of merely advocating technical instruction. It would be a parallel case to that of carrying coals to Newcastle to come to the Massachusetts Institute of Technology on that errand, for your institute has been described by a member of a British royal commission on technical instruction, after an exhaustive inspection of all the technical schools in existence, as the best technical school in the world, and my hearers realize, no doubt, to the full the advantages of technical instruction. If it were my object to endeavor to convert an audience to believe in technical instruction, I could introduce, I think, many convincing arguments and enlarge upon the facts that I have already placed before you to a considerable degree, but I will content myself by repeating a few sentences from a recent British blue book containing conclusions that have been arrived at by a few English educationalists on a visit to Germany with a view of ascertaining the progress of technical education in that country. They conclude as under:

"We shall have accomplished all we hoped to do as the result of our somewhat hasty mission if we succeed in showing that there is no evidence of standing still or of being satisfied with past progress in any direction in Germany. Everything is still being developed, and in all branches of industry there are signs of great activity. New factories are being erected and new processes are being invented. Indeed, there are indications that in the immediate future we in England will have to encounter a competition far more acute than anything they have yet had to grapple with. In the coming struggle for trade our fine insular position, our splendid race of workers, and our excellent raw materials will undoubtedly count for much, but the possession of these advantages alone will not suffice, and we shall have to adopt certain of the methods which prevail abroad about which our manufacturers in the past have cared too little, but which mean much to our customers."

I will also read another sentence from the same report, which contains the opinions of the very able United States consul at Chemnitz, in Germany, Mr. Monaghan, whose advocation of technical instruction in the United States has been energetic and continuous. He informed the gentlemen whom I have just referred to that he had no hesitation in saying that if the United States and Great Britain did not meet Germany more thoroughly and more practically in technical schools, each would in the course of a few years be compelled to yield to Germany the first place in all the higher and more profitable fields of manufacture and commerce.

When I was asked to address you on the subject of technical education in Europe, I was unaware as to what method of treating the subject would most interest you. The subject is a huge one, and every branch of it cannot be dealt with in the course of a single address. I have, therefore, only strung together a few facts that have come under my observation during the time that I have been engaged in connection with technical education in Europe, and have referred briefly to some of the schools in various European countries which I have had the opportunity of inspecting.

The Teheran correspondent of the Times writes under date February 8: "Beet root sugar is for the first time being manufactured in Persia, a Belgian company, which for the last two years has been erecting a magnificent factory on the newest principles with electric motors, having last week begun work. Another company has started a glass factory, which is also at work."

ATMOSPHERIC PRESSURE.*

LIKE so many other important scientific discoveries, that of the unearthing of the fact that the atmosphere has weight may be regarded as brought about by accidental and very simple circumstances. Galileo was ignorant of the physics of the atmosphere until quite the closing years of his eventful life. Workmen having occasion to pump water to a considerable height, found to their great surprise that, do what they would, the water refused to ascend in the pipe to a greater height than about 32 feet. Ascertaining that the pump was free from all faults of construction, they decided to appeal to Galileo to learn what could possibly be the explanation of such an extraordinary fact. His answer was a measure of his knowledge of the subject at that time. He assured his questioners that the water rose to a height of 32 feet and no higher because nature abhorred a vacuum, but that this horror did not operate above 32 feet! Before his death he seems, however, to have thought over this curious problem a good deal. No doubt he communicated his views on the subject to his favorite disciple, Evangelista Torricelli, who is found soon after the master's death to be trying to discover how to obtain the weight of the air. It is evident that Torricelli had devoted much thought to the solution of the difficulty. Finally he had taken a glass tube, about a yard long, hermetically closed at one end, open at the other, and, filling it with mercury, plunged the open end into a bowl of the same liquid. There was a space between the mercury and the sealed end of the tube which contained nothing, not even air. Torricelli's first idea seems to have been that the instrument was a means of obtaining just what nature was supposed to abhor—a vacuum—and the empty space thus obtained has ever since been known as the Torricellian vacuum. Another point immediately presented itself to him. Here was the best part of a heavy fluid suspended in mid air without any visible support. Watching the column carefully, he found that, although to the casual observer it was perfectly still, it was in reality perpetually on the move. He rightly conjectured that this was to be explained by changes in the air, which he supposed to be sometimes heavy and dense, at other times light and rarefied. We are also left in no doubt that he had detected another element of disturbance influencing the length of the mercurial column, for he noticed that it was affected by changes of temperature as well as changes of weight, so that, as a matter of fact, he determined the fundamental principles upon which the construction of this invaluable instrument (the barometer) depends.

A description of Torricelli's strange device does not appear to have reached Pascal at Rouen until the year 1646. The young Frenchman immediately set himself to study the whole question. But those were not days when scientific truths could be accepted without something more than a mild protest. The leading church authorities condemned the Torricellian vacuum as altogether repugnant to nature. To Pascal, however, the whole thing was so genuine that the more his work was condemned, the more he was determined to discover some more convincing proofs. A church steeple was utilized to show that the mercurial column sank or rose in the tube according as it was carried up from or down toward the earth. By this simple means his opponents were completely silenced. Robert Boyle, on carefully studying the new instrument, gave it the name barometer (from the Greek baros, weight, and metron, measure), because it measured the weight of the superincumbent atmosphere.

From what has already been said as to the origin of the barometer, there should be no difficulty in understanding that the principle underlying the construction of the instrument is that the free and unfettered air balances a column of mercury varying in height according to the circumstances of the moment, but whose average elevation at the level of the sea is 30 inches.

But we know, because we can ascertain directly, that 30 cubic inches of mercury weigh close upon 15 pounds avoirdupois, and therefore we say that, under normal conditions, the pressure of the atmosphere is 15 pounds on every square inch. If, however, instead of taking such a tiny space as a square inch for our base, we adopt some larger area, the facts at once begin to assume gigantic proportions. Thus, on a square foot, the weight of the air is little short of a ton; on a square yard it exceeds 8¼ tons; and on a square of 10¼ feet side it is 100 tons. What is known as Inner London, an area of 122 square miles, supports an aerial pressure of 3,250,000,000 tons, or considerably over 600 tons to each inhabitant. To arrive at some approximate conception of the immensity of such a weight, we will assume the air over our islands to be converted into coal in the bowels of the earth. Our coal fields now yield about 180,000,000 tons of coal annually and give employment to 600,000 workmen. To bring to the surface the whole of the air which we have supposed turned into coal would occupy this vast army of miners a matter of 18,000 years!

The barometer is perpetually in motion, rising in one locality, falling in another; the aerial envelope is consequently never uniform in weight over any considerable portion of the earth. If we take a map, say of Europe, and place on it in proper position the barometric readings reduced to sea level, at a large number of well distributed stations, at a set hour on any day we shall find that the values group themselves into more or less well-defined areas. Changes are continually in progress, and there is an endless variety of combinations, so that no two successive days present identically the same picture. Although people are familiar enough with the names "cyclone" and "anti-cyclone," few can explain their precise signification. Here it will be sufficient to state merely that cyclonic areas are areas of low barometric pressure, and anti-cyclonic areas are of high pressure. As the weight of the air when the mercury stands at a height of 30 inches is 15 pounds per square inch, it will be evident that a cubic inch of mercury weighs half a pound; so that if the barometric column rises or falls one inch, we know that the weight of the atmosphere increases or decreases by half a pound. The highest and lowest barometer readings, corrected and reduced to sea level, which are on record, have occurred in Asia. On January 14, 1893, the register at Irkutsk, in Siberia, touched 31·792 inches, while at False Point, on the coast of Orissa, on September 22, 1885, the reading was 27·124 inches. These extremes are nearly 4¼ inches apart, and represent a possible change of atmospheric weight of more than 2¼ pounds on the square inch. When applied to extensive regions, these figures really indicate tremendous weights moved about the earth's surface. There are good reasons for believing that the earth feels these enormous changes of weight, and responds to them much in the same way as an orange would respond to the pressure and withdrawal of a finger. It must be remembered that the surface of the globe is dotted all over with moving cyclones and anti-cyclones differing in weight to the extent of many hundreds of thousands of millions of tons, so that the idea that the earth's outer crust is about as unstable as a jelly is not so absurd as it might appear at first sight. It has been calculated that even if the earth were so solid as to have the rigidity of glass, it would still mean that with a barometric range of only 2 inches, we should be at least 3 or 4 inches nearer the center of the earth when the mercury is at its highest than when it touches its lowest point. Whether the variations of barometric pressure contribute directly to the production of earth tremors and earthquakes has not been definitely determined, although the connection is more than suspected. Thus, in Japan, where the barometric fluctuations are more frequent and of greater extent in winter than in summer, earthquakes are fully twice as numerous in the former as in the latter season. It is probably easier to understand that water would be influenced by changes in the weight of the superincumbent air. No doubt this permanent area of high atmospheric pressure accounts for the saucerlike depression of the surface of the ocean known as the Sargasso Sea, a region where large quantities of so-called gulf weed accumulate, very little of the fucus escaping into higher levels. In ballooning we have a practical illustration of the decrease of atmospheric pressure with elevation. No aeronaut would dream of filling a balloon to its utmost capacity with gas before starting on an expedition, for this would mean certain destruction. Rising higher and higher into much more attenuated air, the contained gas expands as the resistance of the atmosphere decreases, and if by miscalculation too much gas has been stored in the interior, the balloon will burst unless the aeronaut takes the necessary precaution of opening the escape valve occasionally. Parachutists afford us examples of another phase of the importance of atmospheric weight.

An interesting phenomenon related to the weight or density of the air is the variation in what is known as its diathermancy, or heat passing through it without being appreciably absorbed. The greater the tenuity of the air, the more nearly diathermanous is it. Many thousands of people visit the Alps every holiday season and are surprised to find how quickly, unless gloves and veils are used, the hands and face are scorched in the sunshine, but they are quite unconscious of any change in the weight or tenuity of the air, which is the principal contributory factor in encouraging the blistering effects of the solar rays. Another physical fact depending upon barometric pressure is the temperature at which water boils. The less the weight of the air, the more readily does the vapor escape from the water and the sooner is the point of ebullition attained. It is usual with us to say that the boiling point of water is at 212° Fahrenheit, but this is so only at the normal pressure indicated by 30 inches of mercury in the barometer. So long as the barometer remains at this height, no amount of firing and stoking will alter the boiling point a fraction of a degree; but increase or reduce the pressure, and the boiling point is immediately increased or reduced. As the boiling point is dependent upon pressure, it has often been used as a ready means for ascertaining the heights of places visited by travelers. However, the lowering of the boiling point is not without its inconveniences, for at altitudes of 8,000 feet and upward, eggs, meat, potatoes and such things cannot be boiled. Nor is the variation of atmospheric pressure without direct influences on mankind. Of late years many medical men have devoted a considerable amount of attention to the density of the air as a valuable therapeutic agent in the treatment of disease.

For some diseases physicians now prescribe compressed air baths, the treatment consisting of an occasional brief imprisonment in an airtight room into which air is pumped until the barometer rises to 50 inches, or a pressure of 25 pounds per square inch, as against 15 pounds in the open. In this dense atmosphere the lung capacity is increased, breathing becomes easier and respiration deeper and slower, while a very curious result is an increase in the shrillness of the voice, singers being able to rise a tone or two higher than under the ordinary conditions of existence. Other patients are ordered to live in a more attenuated instead of in a denser atmosphere, and for this no specially constructed chamber is necessary. Invalids of this class go to reside in sheltered nooks high up in the mountains where the barometer is always several inches lower than it is at sea level. In these elevated resorts the invalids find the natives provided with much larger chests than the lowlanders, and that this peculiarity is due more to the tenuity of the atmosphere than to the mode of life of the people is demonstrated by the gradual distension of the thorax of visitors who remain a few months, the chest measurement increasing by as much as three inches in some cases. On descending to the plain, however, the thorax, under the increased pressure, gradually contracts to its original dimensions.

* Henry Harries, in Longman's Magazine, London. Condensed for Public Opinion.

MIRROR WRITING.

IN parts lxxiv and lxxv of Brain, Dr. F. J. Allen, of Birmingham, England, remarks that a study of the subjective phenomena of left-handed writing, or mirror writing, may help to throw light on the nerve processes concerned in writing and other complex coordinated acts, says the New York Medical Journal. The faculty of mirror writing is probably not at all rare. It may be possessed more or less by most persons, but may remain unobserved. It is apt to be discovered for the first time when some nerve disease renders normal writing difficult or impossible; the patient then falls back on the resource of left-handed writing. Thus mirror writing is often a symptom of nerve dis-

ease; but the disease need not be the cause of the existence of the faculty, but only the cause of its discovery. The author states that he accidentally discovered it in himself when he was a boy, and that, on making the first attempt, he was able to write backward with the left hand without error or hesitation. The most noticeable subjective phenomena, he says, are the following:

1. It is very easy to write in mirror fashion with chalk on a blackboard, co-ordination seeming to be perfect in the movements of the left arm and wrist. But when using a pen with the left hand, there is slight difficulty in some of the movements. There is no hesitation as to the formation of the letters, but occasional awkward movements will produce distorted lines, and there is special difficulty in keeping up a smooth onward movement, the movement of alignment.

2. Writing is only a little slower with the left hand than with the right. In the fastest possible mirror writing there is no error in the form of the letters—only such want of neatness and distinctness as occurs in writing too fast in the ordinary way.

3. The following actions are quite easy: Writing the same thing simultaneously with both hands. Writing backward with the left foot, i. e., scratching on sandy ground, as one sometimes does with the right foot. Using the deaf and dumb finger alphabet in the reversed or left-handed manner.

4. If a new alphabet is learned with the right hand, it can be written with the left; it is not necessary to learn it separately with the left hand; the nervous system, after being trained to any kind of writing with the right hand, is able to send its co-ordinated messages almost equally well to either hand.

5. The assistance of sight is not necessary in mirror writing. Indeed, sight may even impede it; and although it is easy to write left-handed, it is difficult to read what one has written. The author states that when he looks at his mirror writing, it sometimes conveys no meaning to him, and he experiences sensations which are probably much the same as those of a person who is word blind, but retains the faculty of writing. In order to decipher such writing, he says, it is necessary to run the eye along the lines, and so reproduce the sensations which accompany the act of writing. He finds considerable difficulty in reading print reversed by means of a mirror, but hardly any difficulty in reading a book held upside down.

Dr. Allen states that he has no tendency to be left handed, though he might almost be called ambidexter.

The sensations accompanying all kinds of writing, he continues, whether with right hand or left hand, right foot or left foot, are so similar as to suggest that in all cases the messages start from the same region of the brain; but it seems as if a series of commutators existed at a lower level, whereby the impulses could be turned into different channels leading to analogous but sometimes heteronymous groups of muscles. This supports the view that the true graphic center is not coincident with either of the motor centers, but superior to all of them.

MILK AS A DISEASE CARRIER.

DR. ROWLAND GODFREY FREEMAN contributes to the Medical Record an article on milk as an agency in the conveyance of disease. After summing up the disease spread by infected milk and the epidemics, he draws the following conclusions from the study of these epidemics which occurred from the use of this milk:

1. Whenever a case of communicable infectious disease is reported, inquiry into the source of the milk supply should be made.

2. Milk traffic should be separated from houses where people live. The dairy building should be at least one hundred feet from either the house, barn or privy, and should be on a higher level than any of these, and should have a pure water supply of its own. At this dairy building all the dairy work should be done, including the cleansing of pails and cans.

3. It should be unlawful for any one who has come in contact with a sick person (when this sickness is not positively known to be non-contagious) to enter the dairy building or barn or to handle the milk.

4. All men connected with the milk traffic should be compelled to notify the authorities on the outbreak of any disease in their respective abodes, and to abstain from their work until permission to resume is given them by the authorities notified.

5. Cities should accept milk only from dairies which are regularly inspected, and where all the cows have been tested with tuberculin, and those giving the characteristic reaction have been killed and the premises disinfected.

6. The tuberculin test should be applied to all cattle, and those which react should be killed, the owner being reimbursed from State funds. The premises on which such tuberculous cattle have been kept should be thoroughly disinfected. All cattle which are brought into the State should be quarantined until the tuberculin test has been applied.

7. The use of one long trough for the purpose of feeding many cattle should be avoided, since it is a ready means for the conveyance of pathogenic germs from one animal to another.

From the regulations of the New York City Board of Health for the sale and care of milk the following important rule is taken: "Milk shall not be kept for sale or stored in any room used for sleeping or domestic purposes or opening into the same."

Undoubtedly, the adoption of the above regulations would do much in reducing the amount of sickness due to the conveyance of pathogenic organisms by milk. It does not seem probable, however, that any regulations can entirely eliminate this danger.

He advises physicians who order milk diet to use some sufficient sterilizing process, so that in case the milk supplied contains pathogenic organisms they may be destroyed before the milk is used by the patient.

A small balloon carrying self-registering instruments was sent up at Paris (France) on November 14, 1896, and in fifty minutes reached a height of 13,800 meters (over 8½ miles). The lowest temperature registered was 63° Centigrade below zero (about 81° Fahrenheit below zero).

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